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LADIES' BOTANY.

LADIES' BOTANY

OR

A FAMILIAR INTRODUCTION

To the Study

54920

OF THE

NATURAL SYSTEM OF BOTANY.

BY

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ETC. ETC. ETC.

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I boast no song in magic wonders rife,
But yet, oh Nature! is there nought to prize,
Familiar in thy bosom scenes of life?
And dwells in daylight truth's salubrious skies,
No form with which the soul may sympathize?

CAMPBELL.

IN TWO VOLUMES.—VOL. II.

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1865.

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Locke has two sentences which, with little alteration, express in the best possible manner what I would write upon this occasion.

Nature, he says, commonly lodges her treasure and jewels in rocky ground. If the matter be knotty, and the sense lies deep, the mind must stoop and buckle to it, and stick upon it with labour and thought, and close contemplation, and not leave it until it has mastered the difficulty and got possession of truth. And again—

God has made the organic world harmonious and beautiful without us; but it will never come into our heads all at once; we must bring it home piece-meal, and then set it up by our own industry, or else we shall have nothing but darkness and a chaos within, whatever order and light there be in things without us.

The reader will, I am sure, forgive me if I introduce the second volume of this little work without further preface.

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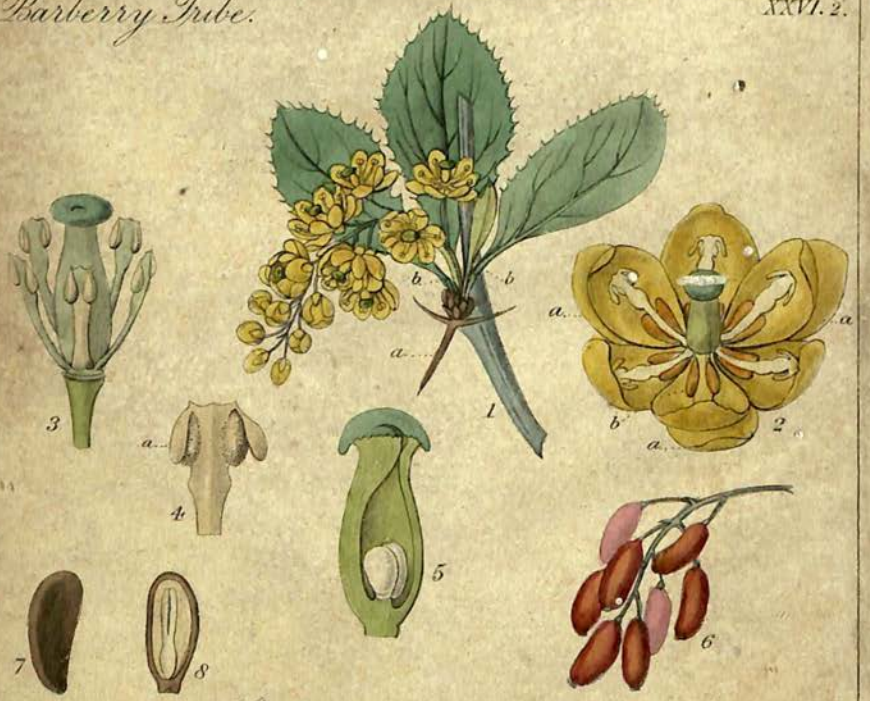
The Magnolia Tribe. XXVI. 1.

Heart-leaved Magnolia.

The Barberry Tribe. XXVI. 2.



Common Barberry.

LETTERS ON BOTANY.

LETTER XXVI.

PRELIMINARY—THE MAGNOLIA TRIBE—THE BARBERRY TRIBE.

(*Plate XXVI.*)

At the close of our Botanical correspondence two years ago, I had given you an unfinished, but rather extensive, sketch, of the structure and classification of a considerable number of interesting plants; and I then supposed that, for all elementary purposes, I had already occupied so much of your time as to have run the risk of wearying rather than amusing you. The sketch, indeed, was far from comprehending all the beautiful objects by which the admiration of a lover of flowers is excited, nor did it include a complete view of even the most common species that are yielded by our own woods and fields and hills; but it furnished you with a plan of study, it taught you the right manner of exercising your powers of observation, it explained many of the more important facts connected with the organization of the Vegetable World, and it was calculated to place you in a position

from which you might proceed as much further in the pursuit of this pleasing science as taste or opportunity might lead you. I had no expectation that my letters would form even an epitome of the most common facts. They were merely intended as an experiment upon the possibility of conveying strictly scientific knowledge in a simple and amusing form, and of showing that Botany is by no means that dry, difficult, repulsive subject, which it may well appear to those who only know it through the uninviting medium of systematic works. I thought it practicable, without at all deserting science, to divest her of the severe, forbidding features that she puts on when dressed in the starched, old-fashioned, matter-of-fact costume of the schools, and to shew that it is in her wild and unsophisticated state that she shines forth in all her smiles and loveliness, when her flowers are newly gathered, their colours fresh, and their fragrance unimpaired, and not when every thing is dry and withered, and formally labelled with the Greek and Latin names of science. I was, moreover, anxious that the endless variety of beautiful objects which the Vegetable world so prodigally strews before our path should, with those who from their habits of life and their gentler feelings are the most sensible to the charms of nature, become something beyond a vague sentiment of undefined admiration. The love for flowers is a holy feeling, inseparable from our very nature; it exists alike in savage and civilized society; it speaks with the same powerful voice to the great and wealthy and to the poor and lowly; it

grows up and flourishes with our innocence, and it only perishes with the best and truest feelings of humanity.

——————O Father Lord!
The All-Beneficent! I bless thy name,
That thou hast mantled the green earth with flowers,
Linking our hearts to nature! By the love
Of their wild blossoms, our young footsteps first
Into her deep recesses are beguiled,
Her minster cells; dark glen and forest bower,
Where, thrilling with its earliest sense of Thee,
Amidst the low religious whisperings
And shivering leaf-sounds of the solitude,
The spirit waits to worship, and is made
Thy living temple. By the breath of flowers
Thou callest us, from city throngs and cares,
Back to the woods, the birds, the mountain streams,
That sing of Thee! back to free childhood's heart,
Fresh with the dews of tenderness!—Thou bidd'st
The lilies of the field with placid smile
Reprove man's feverish strivings, and infuse
Through his warm soul a more unworldly life,
With their soft gentle breath. Thou hast not left
His purer nature with its fine desires,
Uncared for in this universe of thine!
The glowing rose attests it, the beloved
Of poet hearts, touched by their fervent dreams
With spiritual light, and made a source
Of heaven-ascending thoughts. E'en to faint age
Thou lend'st the vernal bliss:—the old man's eye
Falls on the kindling blossoms, and his soul
Remembers youth and love, and hopefully
Turns unto Thee, who call'st earth's buried germs
From dust to splendour; as the mortal seed
Shall, at thy summons, from the grave spring up
To put on glory, to be girt with power,

And filled with immortality. Receive
Thanks, blessings, love, for these, thy lavish boons,
And, most of all, their heavenward influences,
O Thou that gav'st us flowers!

"La vue d'une fleur," says Madame Roland, "caresse mon imagination et flatte mes sens à un point inexprimable—elle reveille avec volupté le sentiment de mon existence—sous le tranquille abri du toit paternel, j'etais heureuse dès l'enfance avec des fleurs et des livres—dans l'étroite enceinte d'une prison, au milieu des fers imposés par la tyrannie la plus révoltante, j'oublie l'injustice des hommes, leurs sottises et mes maux, avec des livres et des fleurs."

How much stronger and more permanent an influence must those feelings exercise upon our nature when the lovely objects that give rise to them are known by something beyond a name, or a favourite colour, or a delightful fragrance; when we are acquainted with their structure, and so familiar with their habits as to understand how it is they grow and live and multiply, and to what uses they may be applied, and by what contrivances, equally simple, invariable, and surprising, a small number of elements constitutes all those different organs, whose singular forms and brilliant colours so continually excite our admiration.

The power and wisdom of the Deity are proclaimed by no part of the Creation in more impressive language than by the humblest weed that we tread beneath our feet; but we must learn to understand the mysterious language in which we are addressed

and we find its symbols in the curious structure, and the wondrous fitness of all the minute parts of which a plant consists, for the several uses they are destined for. This, and this only, is the "language of flowers;" and it was of this that I hoped in my former letters to give you some idea.

You tell me, however, that your curiosity is still unsatisfied, that you know not where to seek for other books in which similar information is to be found, and that the progress of your children in the classification of the various objects that surround them is accompanied by doubt and disappointment. I might easily name to you the very books you should read, and point out to you the very places in which you should search for the information you require, but I fear that you would still retain your opinion that it would have been better if, instead of idly referring you to the elucidations of others, I had had the industry to carry our correspondence a little further. Well then, let it be so! innocent knowledge is the best and most enduring foundation of permanent happiness, and far be it from me to refuse my humble assistance in contributing to the means by which the world may secure to itself the utmost amount of simple pleasures.

We will, therefore, resume our correspondence upon Botany; and this time, if your patience should not be exhausted, I promise to provide you with sufficient means for carrying your inquiries to whatever point you please, in respect of all those subjects which you would think of investigating for mere amusement's sake. In the first place you shall have an account of

those common tribes of plants about which I have, as yet, said nothing; then you shall learn to which of such tribes all the common plants both of the fields and the gardens belong; and finally, I will give you a little sketch of the general classification of those which have been previously brought before you only in detail. With this I may combine, when favourable opportunities occur, short episodes relating to the internal structure of plants, and the manner in which they grow; and, thus, I trust that an air of life and truth will be given to all the picture.

This will, I hope, fulfil your expectations, or, at least relieve me from the reproach of unwillingness to satisfy your curiosity so far as my skill will permit me.

Suppose we begin with MAGNOLIAS, those beautiful American trees, which form the pride of European gardens, and the glory of the forests of North America, and many parts of Asia.

Observe that noble looking evergreen, with its large, shining, bright green leaves, in the bosom of which are reposing some cream-white flowers, much larger than any others you ever saw, and with a pile of purple and yellow stamens heaped up in their centre. That is the *Big Laurel* of the Americans, the *large-flowered Magnolia* (Magnolia grandiflora) of Botanists, and the handsomest of its tribe. It is found wild in the warmer parts of the United States, especially in South Carolina and the Floridas, and it shrinks from the cold weather of more northern climates. In its native

forests it grows as much as ninety feet high, which is as high as the largest tree you ever saw in this country, and much higher than any even of the beautiful old elms that are scattered about in the park before you. A specimen of this size is described by a French Botanist as surpassing all other trees, "par son port majestueux, son superbe feuillage, et ses fleurs magnifiques." In this country it is too delicate to endure the blasts of our bitter winters, without some protection; but, as you see, it is very happy beneath the shelter of a wall, and pays no attention to the bonds with which it is secured to its prison. Beautiful as are its huge goblet-shaped blossoms, and surpassingly delicate as its buds of polished alabaster, it wants the rich perfume of many of its kindred. There is the *glaucous* Magnolia with smaller flowers, and leaves having a blueish bloom beneath them, by which nature points it out to the gatherers of the bark that cures the fevers so frequent in the unhealthy swamps where it delights to grow; and the *long-leaved Cucumber-tree* (Magnolia auriculata), so called because its leaves taste like Cucumber, with its spreading foliage, which has given it and some others the name of Umbrella trees; and the *long-leaved Umbrella tree* (Magnolia macrophylla), whose leaves are sometimes three feet long; these are species whose delicate cup-shaped flowers fill the air with their perfume. It is, however, in the East and not in the West that the Magnolia tribe has its fragrance most elaborated. In the *dwarf Talauma* of the Chinese (Magnolia pumila), with its yellow and brown

flowers, and the *Tsjampaca*, the most beautiful of trees, beneath whose majestic foliage the native Indian constructs his cottage of Bamboo stakes and Palm leaves, the essence of the Magnolia perfume is developed in all its power. These trees are indeed the living altars from which a perpetual cloud of incense is ascending unto heaven day by day, as if in gratitude for the profusion with which the gifts of Nature are so prodigally poured forth from the lap of earth in those favoured regions.

After such an account as this you will be surprised to hear that Magnolias are nearly akin to the Crowfoot tribe (*Vol.* 1. *p.* 13. *t.* 1. 1.); that those beautiful trees, with their fragrant flowers and noble leaves, are related to such weeds as the wild Ranunculus, and the Thalictrum. And yet, such is undoubtedly the fact. Just observe the construction of the flower of this *heart-leaved* Magnolia (*Plate* XXVI. 1.). You see it has a calyx of three small reflexed sepals (*fig.* 1. *a.*); and six upright, yellowish, rather leathery petals, of which three are something narrower than the others. Within these are placed many stiff stamens (*fig.* 2.), arranged in several rows upon a receptacle of a somewhat conical figure (*fig.* 3. *a.*); each anther has two cells placed at the edge of a stiff fleshy filament (*fig.* 4.), and the cells are so situated that when they open the pollen will fall out on the side next the petals (*fig.* 3.); this kind of anther is what is called technically *extrorsal.* In the centre of the flower is a large number of carpels, each of which contains one cell with two ovules in it

(*fig.* 3.), and is terminated by a narrow thread-shaped stigma (*fig.* 3. *b.*), Those cells grow together into a solid pistil, and eventually change to a cone-like fruit, the seeds of which are principally composed of albumen, with a tiny embryo lying perdu in its base.

Such is the general structure of the heart-leaved Magnolia, and in what points of importance does it differ from a Ranunculaceous plant? It has a calyx of three sepals; so has Ranunculus Ficaria; it has six petals, so have many Anemones; its stamens are numerous, and placed on a receptacle beneath the carpels, their anthers grow to the edge of the filaments, and the carpels are very numerous; in all these things it agrees with Ranunculus itself; but the carpels grow to one another: the same things happen in Love in a mist (Nigella); and, finally, the nature of the seed of a Ranunculus and a Magnolia is nearly the same. Are these plants then nothing but Crowfoots of a larger growth? merely Ranunculaceous plants with the stature of forest trees? Not quite so. The two orders are, as I have already stated, nearly akin to each other, but they belong to different races, and may be certainly enough distinguished. Do you see how each of these branches of the Magnolia is terminated by a little horn that springs from the base of the last leaf? (*fig.* 5. *a.*); that horn is a pair of stipules rolled together for the protection of the next leaf that is to be born; and that next leaf has a similar pair of stipules that roll up over the still younger leaf lying in its bosom; so that if you cut into the horn you will behold several generations of leaves lying enfolded the

one within the other; this is the great mark of the Magnolia tribe, and enables you immediately to distinguish it, not only from the Crowfoots, but from most of those allied to it. And this is not only a curious but an important and highly interesting mark of distinction; the growing point of a branch of a Magnolia is tender, and requires to be carefully protected from the air, and from cold, and from those accidents to which all things must necessarily be subject that are directly exposed. To guard this tender part nature has many singular, but always most efficient, contrivances: in this instance the stipules are made to perform the business of protection.

The fruit of Magnolias differs in some respects from that of the Crowfoot tribe: especially in becoming large cones, from the back of which the seeds often hang down by long cords; but as Magnolias do not produce their fruit in this country it is unnecessary to describe this part of their structure.

Besides the plants called Magnolias, the curious *Tulip-tree* (Liriodendron tulipifera), one of the largest trees in the American forests, belongs to the present Order. You may know it by its singular truncated leaves, which look as if they were cut off at the end, and by its large pale green and purple flowers. It is not uncommon in the pleasure grounds of the old gentry of this country; some of the finest are to be seen at Sion, the seat of the Duke of Northumberland.

From these let us turn to a not less interesting, but more humble race of plants, of which the common

BARBERRY may be taken as the representative (*Plate* XXVI. 2.). This plant is so common in plantations and pleasure grounds, that all persons would be acquainted with it, if it were only for the quantities of bunches of red succulent acid fruit with which it is loaded in the autumn; and for its evil reputation as a poisoner of wheat when it grows in the hedge-row of a corn-field.

You will find the branches of this bush covered over with sharp spines (*fig.* 1. *a.*), some of which are divided into three, or five, or even a greater number of lobes, and some of which are undivided. What think you are these? Not prickles like those of the Rose, for they are regularly arranged over the stem, and will not break off by a slight pressure sideways; nor spines like those of the Hawthorn, for in the Hawthorn the spines originate in the bosom of leaves, but in the Barberry the leaves originate in the bosom of the spines. These parts are an exceedingly curious state of the leaf. They are the first kind of leaf that the Barberry produces when it shoots forth from the bud; but immediately after, or perhaps at the same moment with, their production other perfectly formed leaves break out from their axils, and thus at nearly the same instant, the branches are covered with spines for their defence, and with leaves for their adornment. That these spines really are leaves you may easily ascertain by looking for a very vigorous shoot of the Barberry, when you will find some of them with the space between the stiff spiny lobes filled up by a web of parenchyma, others with the web hardly visible, and others with the spines alone remaining.

The leaves are themselves bordered by spiny teeth which are the points of their veins, and there is a little joint near their base (*fig.* 1. *b.*), by which they are articulated with their stalk.

From the midst of a cluster of leaves appear the yellow flowers, in a drooping raceme something like that of a currant. Each flower consists of three little external scales tipped with red; they are the outermost sepals; then of three petal-like parts (*fig.* 2. *a.*), the inner sepals; and within these of six genuine petals. The great similarity between the parts thus differently designated shews you that the distinction between a calyx and corolla is in many cases very arbitrary, although in other instances it may be plain enough. At the base of each of the true petals are two parallel yellow oblong glands (*fig.* 2. *b.*), the nature and use of which is unknown. Between these glands and opposite to the petals are the stamens, six in number, consisting of a filament somewhat thickened at its upper end (*figs.* 4. & 5.), and an anther whose lobes, growing to each side of the end of the filament, have a singular mode of opening. At first the lobes resemble those of any common anther, but when the time comes for the fertilization of the stigma, instead of splitting along the middle, the anther opens at the edge all round, except near the point, and liberates its valve or face, which curves back and allows the pollen to drop out (*fig.* 4. *a.*). This is a very curious phænomenon, and is technically called *bursting by recurved valves.*

The ovary is an oblong body (*fig* 3.), terminated

by a flattish, round, sessile stigma, in the centre of which is a small opening that communicates with the single cell (*fig.* 5.) that the ovary contains. From the bottom of the cell, but rather obliquely, there arise two ovules (*fig.* 5.).

In time the ovary changes to an oblong acid scarlet fleshy berry (*fig.* 6.), containing one or two seeds (*fig.* 7.). The seeds have a tough skin, and enclose a slender embryo (*fig.* 8.) standing erect in the midst of hard albumen.

In this plant you will at once perceive several circumstances that you have not previously seen. In the first place its stamens are the same number as the petals, and opposite to them; and secondly their anthers open by recurved valves. These two points taken together, limit the Barberry Tribe, which contains the beautiful evergreen Ash-leaved species, or Mahonias, of which Berberis aquifolium or the Holly-leaved is so striking an instance, and also the singular brown-flowered Epimedium, whose small unattractive blossoms just raise themselves upon their thread-shaped stalks, and peep forth from the leaves which half shroud and half reveal them.

In the flower of the Barberry is a curious instance of irritability. The stamens are in a recumbent position when the flowers first open, lying back close-pressed upon the petals. But if you touch one of their filaments with a pin, the stamen gently rises up and strikes its anther against the stigma, just as the figures in old fashioned clocks strike their hammers upon the bells when chimes are sounded. No one

knows the cause of this curious habit; it is one of those certain but inscrutable facts, the explanation of which is probably beyond the faculties of man. There is one thing, however, connected with it that deserves to be noticed, although it does not throw light upon the nature of the phænomenon. If you dose the Barberry with laudanum or any opiate, the stamens are stupified and lose their elasticity; and if you poison the plant by some corrosive substance, such as arsenic, which produces inflammation in animals, a sort of vegetable inflammation is produced in the stamens of the Barberry. We are not, however, on that account to conclude that this plant approaches animals in its nature, but merely that the principle of life which pervades all nature is the same in its essence, and is affected in a similar manner by similar causes, whether it exists in an animal or a vegetable.

EXPLANATION OF PLATE XXVI.

I. The Magnolia Tribe.—1. A full-blown flower of *Magnolia cordata*, the natural size, showing the sepals *a*, and the six yellow petals, in the midst of which are seen the stamens and a small portion of the carpels.—2. The stamens without the petals, together with the mass of carpels in the middle.—3. A vertical section of the latter part, a little magnified; *a* shows the elevated receptacle, over the outside of which the numerous stamens are arranged; at *b b* are seen the stigmas with their uneven inner edge admirably adapted to collecting the pollen; and below some of the styles are the cavities of the ovary, in each of which are two ovules.—4. is a filament and anther, a little magnified.—5. The lower part of a leaf and its petiole, with its horn-like hairy stipule; at *a* is seen the scar of the opposite leaf which had dropped off, and *b* shews a portion of the end of the branch.

II. The Barberry Tribe.—1. A twig of the common Barberry (*Berberis vulgaris*), with a spine-like leaf at *a*; at *b* is a line showing where the leaf is jointed with its petiole; natural size.—2. A full-blown flower, magnified, shewing the three inner sepals *a*, the six petals, each with a pair of parallel glands *b* at the base, the six stamens, and the central superior ovary; the outer sepals are too small to be seen in this direction, but they are visible upon the flowers in fig. 1.—3. A magnified view of the ovary, deprived of the floral envelopes, and showing the origin of the six stamens.—4. The upper end of a stamen, magnified; at *a* is seen the singular mode in which the anther bursts by recurved valves.—5. A vertical section of the ovary, much magnified; the two erect ovules, and the open communication between the stigma and the cavity of the ovary, are plainly shewn.—6. A bunch of fruit, natural size. 7. One of the seeds, magnified.—8. A section of the same, shewing the dicotyledonous embryo standing erect in the midst of the albumen.

LETTER XXVII.

PISTIL—THE GOOSEBERRY TRIBE—THE VINE TRIBE.

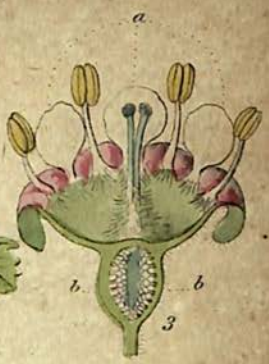
Plate XXVII.

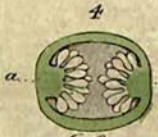
Is it possible that I should no where have told you the meaning of the common word *pistil?* You say you perfectly understand what a carpel is, but that you do not find in what respect a pistil differs from it. I am ashamed of my negligence, and hasten to repair it. The general name of the young fruit, consisting of ovary, style, and stigma, is pistil; the pistil is usually composed of several carpels, each of which has its own ovary, style, and stigma, as in a Ranunculus, where the mass of the carpels is the pistil; but it may consist of but one carpel, as in the Barberry, and in that case the words carpel and pistil have the same meaning.

Premising this, let me direct your attention to the GOOSEBERRY TRIBE, of which not only the plant that gives it its name, but all the currants are likewise members.

Currants you know are not confined to the kitchen garden; for besides the red, the white, and the black currants, every-body now possesses the sweet-scented yellow currant (*Ribes aureum*), the crimson currant (*Ribes sanguineum*), and other beautiful species which have been snatched from their native rocks and wilds

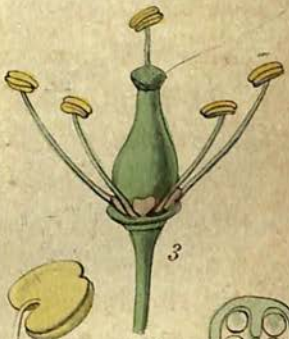
The Gooseberry Tribe. XXVII. 1.





Common Gooseberry.

The Vine Tribe. XXVII. 2.



The Grape Vine.

in New Albion to adorn the gardens of even English cottagers.

There is something in the organisation of these flowers particularly simple and pretty. Take the *Common Gooseberry*, for example (*Plate* XXVII. 1.). The spines with which the stem of this plant is defended, are of the same nature as those of the Barberry, that is to say they are rigid leaves, without the soft green pulpy substance, or parenchyma, that usually connects their veins. In the true leaves there is nothing to remark upon, further than that they are somewhat 3-lobed, and bluntly toothed along their margin; their stalks, however, are beautiful objects if examined by a microscope, because of the delicate border of half-transparent hair like fringes, which, when magnified, look like the most brilliant needle-shaped crystals. The flowers are little green cups, purple in the inside, and grow in pairs, or singly, from among the leaves, which overshadow and protect them so completely that when a bush is in full flower you may pass it and hardly remark the blossoms. The cup (*fig.* 2.), green without and purple within, is the calyx; its border is divided into 5 blunt lobes, which are turned downwards. At the mouth of the cup you will find 5 tiny whitish scales, having each a short stalk with a tuft of hairs at its base (*fig.* 3 *a.*); these are petals. Between the petals are the stamens: 5 upright filaments, with an oval anther at the point, and a tuft of hairs at its base (*fig.* 3.). In the centre of all this apparatus rise two green threads, covered with long hairs at the base, but naked and terminated by a small

stigma; of course these threads are styles: where then is the ovary? You shall see. Just below the cup of the calyx and above its stalk is a small oval swelling, clothed with long delicate hairs; it is hollow, and bears a great number of ovules, arranged in two lines upon its sides (*fig.* 3. *b.*); the styles are planted upon its summit; this then is the ovary, from which the gooseberry is to be produced. You could hardly have anticipated, before you began to study this science, how curious and complicated an apparatus is necessary for the production of so simple a fruit; everything you see is perfect, and in this tiny flower you have all the parts which you could find even in the gigantic Magnolia, only not so many of them, and differently arranged. And so it always is; be quite sure that in what may seem to you the most insignificant parts of the creation, there is the same foresight, the same admirable contrivance, the same beautiful adaptation of every part to the end it has to answer, and the same care to ensure against all accidents its multiplication after its kind, as in what we may habitually look upon so inconsiderately as the most perfect of the Creator's works. When rightly examined it will be found that no one thing is more perfect than another; each is perfect after its kind; imperfection is unknown in the creation; to argue otherwise is to argue against the power and wisdom of the Deity.

After a time the calyx-cup, the petals, stamens, and styles, shrink up and decay: at the same time the ovary swells, the hairs upon its surface either harden or fall off, its interior becomes succulent, the ovules

change to seed, they elevate themselves upon long stalks, and immerse themselves in the pulpy interior, the colour of the whole changes to red or yellow, and the ripe Gooseberry is completed.

If at this time it is divided into two parts from its apex to its base, it will be found to consist of a soft watery mass enclosed in a tough skin, which is the pericarp, and containing several hard seeds of a deep brown-purple colour, originating from a sort of web-like placenta. These seeds are secured by a green thread, which passes from one end to the other of the seed, on one side, forming a raphe (*fig.* 6. *a.*), and ending in a broadish expansion, or chalaza (*fig.* 6. *b.*). Within the skin, which is thick and tough, is a large quantity of hard albumen, at the base whereof lies a small dicotyledonous embryo (*fig.* 7.).

The common eatable Currants, and several other species found in different parts of Europe and Asia, are very like it; but this is not the case throughout the whole tribe. For example, the *Crimson Gooseberry* (Ribes speciosum), has a rich deep red calyx, with long narrow segments, and stamens projecting so far as to resemble those of the Fuchsia (*see Botanical Register, tab.* 1557.). In the *golden-flowered Currant* (Ribes aureum), the calyx is a bright clear yellow, with a long yellow tube, and the petals and stamens are short as in the common Gooseberry. These are the different forms of the Gooseberry-tribe. Considering the manifest resemblance between a bunch of Currants and a bunch of Grapes, you will not be sur-

prised at hearing that the Vine has some relationship with the Gooseberry tribe. This I now proceed to explain to you.

The common Vine, a native of the South of Asia, is the type of the VINE TRIBE (*Plate* XXVII. 2.). It has, as you know, very large lobed leaves, not at all unlike those of a Currant magnified, and its flowers grow in clusters, which however are not racemes, but panicles, that is to say, branched racemes (*fig.* 1.). The stem too is not that of a bush, but long and weak, and requires the support of other trees, to avail itself of which it is supplied with tendrils. Here let me pause to tell you what a tendril is; by its name you would suppose it some special kind of organ formed expressly for the purpose of helping the Vine to raise itself among the forests it naturally inhabits, and to ascend from the shady thickets where it is born, to the free light and air that are necessary for its existence. Not at all; this is not the plan of Nature. Plants are furnished with certain general parts, such as leaves, flowers, &c., and when any particular and unusual office is to be performed, some one of these parts is specially altered in order to meet the exigency. Thus in Combretum the stem is enabled to rise among other bushes by the soft and yielding stalks of its leaves being changed into stiff inflexible hooks; in the Sweet Pea the same office is performed by the principal leaf-stalk, which lengthens, branches and twists itself round bushes and the branches of smaller shrubs. In some plants indeed this office is actually performed by

the tips of the petals. In the Vine the arrangement is different from all those just mentioned; and equally simple; a considerable number of supernumerary panicles are prepared, on which no flowers are formed, but in their room a power of twisting round adjoining bodies is communicated to the branches; and these form what we call tendrils. But to return to other matters.

Each flower of a Vine (*fig.* 2.) consists of a calyx without any lobes to it (*a.*); five petals (*b.*) that hold together at the point, separate at the base, and are carried upwards with the extension of the stamens; of five stamens (*fig.* 2. *c.* and *fig.* 3.) opposite the petals, with long thread-shaped filaments and small oval anthers; of five glands alternating with the stamens (*fig.* 2. *d.*); and of a two-celled superior ovary, with a sessile roundish stigma (*fig.* 3.). In each cell of the ovary are two upright ovules (*fig.* 5. & 6.). The fruit is, as you know a succulent berry, with one, or two, or three, or four, hard seeds nestling in the pulp (*fig.* 7.). These seeds are not a little curious; each has a pear-shaped figure (*fig.* 8.), and consists firstly of a tough external even coating, and secondly of a wavy bony lining, which does not follow the form of the outer skin, but puckers up, if I may so say, and forms a pear-shaped stone convex on one side, but with two deep furrows on the other, so that when you cut through it crosswise it looks almost like the letter T (*fig.* 9.). In the inside of the stone is a hard albumen, at the base of which (*fig.* 10.) lies a tiny embryo (*fig.* 11.).

This is the general character of the Vine tribe, the genera and species of which usually deviate so little from the Vine itself, that you would hardly fail to recognise them at the first glance. The *Fox grapes* of America (Vitis Labrusca and others) are, for instance, Vines with broader and more woolly leaves, and berries with a vile indescribable taste; the *River-grape* (Vitis odoratissima, or riparia), the delicious odour of whose flowers makes ample amends for their minuteness, would be taken for a common Vine if its leaves were not less lobed and more heart-shaped, and its berries so small, and black, and acid; while the *American creeper* (Ampelopsis quinquefolia), with its rich autumnal mantle of crimson, and the various kinds of Cissus, deviate from the ordinary appearance of the Vine chiefly in consequence of the leaves being separated into several distinct pieces.

Considering how common, and how useful a plant the Vine is, it is worth pausing here to consider a little, to what other plants it is most related; and I am the more inclined to do so because you like to be surprised, and some of its relations are undoubtedly of a very surprising character. What say you to Hemlock? I think I see you throw down my letter with what would be astonishment, if it were not for the incredulity mixed up with it. And yet I am not mystifying you, but in plain, sober, serious English, I say that the Vine and the Hemlock are nearly related to each other. For the proof;

The VINE *has*	*The* HEMLOCK *has*
Leaves deeply lobed, alternate upon the stem, with a stalk which is a good deal dilated at the base.	Leaves deeply lobed, alternate upon the stem, with a stalk which is a good deal dilated at the base.
A calyx with scarcely any lobes.	A calyx with scarcely any lobes.
A corolla with five petals.	A corolla with five petals.
Five stamens.	Five stamens.
A two-celled fruit.	A two-celled fruit.
Seeds with a very small embryo lying at that end of the albumen which is next the hilum.	Seeds with a very small embryo lying at the end of the albumen which is next the hilum.
An albumen deeply furrowed on the inside.	An albumen deeply furrowed on the inside.

In these points, which are of first rate consequence, affecting the whole nature of the plants, you perceive that the two are the same. But

The VINE *has*	*The* HEMLOCK *has*
A superior ovary.	An inferior ovary.
Erect seeds.	Pendulous seeds.
Stamens opposite the petals.	Stamens alternate with the petals.
A pulpy fruit.	A dry fruit.

And some of these differences, slight as they are, are calculated to produce a considerable difference in the general aspect of the two plants, independently of the Vine being a woody climbing plant with panicled flowers, and the Hemlock a herbaceous biennial plant with umbelled flowers.

My proof of the relationship of the two plants does not however stop here, but is strengthened by other means. It is easy to shew a direct transition from the Vine to the Hemlock by a very brief examination of the plants that stand between the one and the other

in a natural arrangement. Observe, the Vine is a Vitaceous plant, the Hemlock an Umbelliferous plant; to state this is to simplify the discussion.

Umbelliferous plants are allowed upon all hands to be distinguishable from Araliaceous plants, only by their fruit consisting of two parts instead of more, and by their fruit being dry instead of succulent.

Araliaceous plants are therefore Umbelliferous plants with succulent fruit. The common Ivy may be taken as a representative of the former. Many of the East Indian Ivies have their fruit in just such clusters as the Grape, and their leaves as much divided as in the Virginian creeper, so that they differ from Vitaceous plants only in their inferior fruit, pendulous seeds, and stamens alternating with the petals. Their close relationship is therefore unquestionable.

Then, if Vitaceous plants are closely akin to Araliaceous, and Araliaceous to Umbelliferous, it follows that Umbelliferous must be nearly allied to Vitaceous through Araliaceous, and consequently the Hemlock must be related to the Grape, as I at first told you. I hope you are now satisfied.

EXPLANATION OF PLATE XXVII.

I. The Gooseberry Tribe.—1. A twig of the common Gooseberry *(Ribes Grossularia)* in flower, natural size.—2. A separate flower magnified, with the bractlets at *a*, and the inferior ovary at *b*.—3. The same divided in two, perpendicularly, and still more magnified; at the base is seen the one-celled ovary, with the two parietal placentæ *b*; *a* points to the petals.—4. Shews the appearance of a magnified transverse

slice of the ovary, with the numerous ovules crowded over the placentæ *a a*.—5. is a section of a ripe fruit, shewing the remains of the flower adhering to its apex, and the seeds attached to the placentæ *a a*, by their long stalks.—6. is a magnified view of a seed with its stalk, raphe *a*, and chalaza *b*.—7. A section of the same, to show the embryo lying in the base of the albumen; *b* is the chalaza.—8. is an embryo much magnified.

II. The Vine Tribe.—1. A portion of a bunch of flowers of the common Grape *(Vitis vinifera)*.—2. A magnified flower in the act of opening; the calyx *a* is at the base in the form of a cup; the stamens *c* are pushing off the petals *b*; *d* are the glands of the disk.—3. Is the same flower after the petals have dropped off, and the stamens are liberated; here the ovary, with its sessile stigma, is distinctly seen in the middle.—4. A portion of a stamen magnified, with the anther in the position it occupies when heaving up the petals; see how it bends its shoulders (I beg pardon, its shoulder) to the task.—5. A magnified view of the longitudinal section of a young grape; *a* the calyx; *b* a ring from which the petals separate; *c* the glands; *d* the stigma. The ovules are standing erect in the two cavities.—6. A magnified view of a slice of the ovary, showing that there are two ovules in each cell.—7. A section of a grape-berry.—8. One of the seeds.—9. A transverse section of the last, shewing the external coat and the internal stone.—10. A vertical section of the same, with the little embryo at the base of the albumen.—11. A highly magnified view of the dicotyledonous embryo.

LETTER XXVIII.

THE PITTOSPORUM TRIBE—THE MILKWORT TRIBE.

Plate XXVIII.

It is a common statement that New Holland produces no eatable fruits, for that even the few wild berries which the traveller meets with are more dry, tasteless and insipid than those of any other country. The Pears,* say the grumbling colonists, are made of wood, Cherries† have the stones on the outside of the flesh, Grapes‡ are nauseous, and grow on Bindweed, the Currant-bushes§ prickly, and the Gooseberries‖ without thorns, while the Honeysuckle¶ has no odour, and the Oak** no foliage. Although these are mere idle tales, arising from the names of European plants being misapplied to New Holland species of a totally different nature, yet it is true that the whole of that vast continent is, as far as has yet been seen, destitute of any fruit-bearing plant that deserves cultivation.

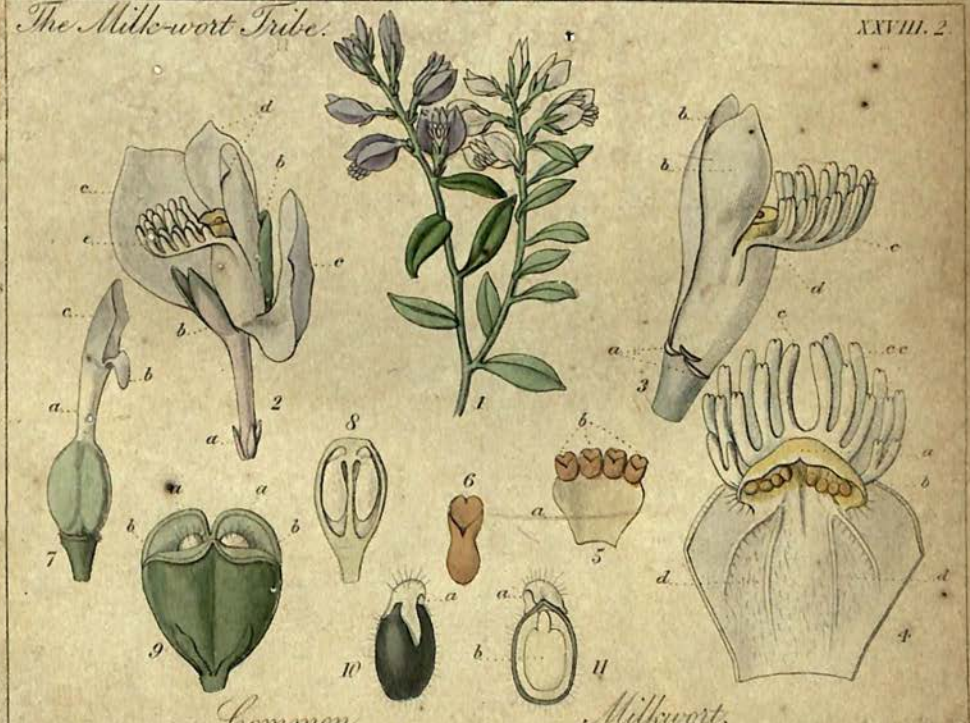
The nearest ally of the Grape and the Currant for instance, is a beautiful twining evergreen plant with small dark green leaves, and large berries of the deepest

* Xylomelum pyriforme.
† Exocarpus cupressiformis.
‡ Polygonum adpressum.
§ Leucopogon.
‖ Gaultheria.
¶ Banksia.
** Casuarina.

The Pittosporum Tribe. XXVIII. 1.

Various leaved Sollya.

The Milk-wort Tribe. XXVIII. 2.



Common Milkwort.

lapis lazuli blue, resembling nothing so much in colour, and, to appearance, even in texture, as the fine deep blue of the porcelain of Sèvres. It has small greenish-yellow bell-shaped flowers, and Botanists call it Billardiera; in Van Diemen's Land, where it is extremely common, the name of *Apple-berry* is applied indiscriminately to all the species. This most lovely fruit, although, as I shall presently show you, nearly akin to the Vine, has none of its delicious flavour, but is a mere mass of cottony, or rather spongy, dry pulp, which would be tasteless if it were not for a dash of turpentine which is perceivable. If you do not possess the Billardieras already, let me advise you immediately to procure them for the low treillage in front of the conservatory, where they may be kept very well in mild winters, if protected with a little straw or a mat.

Sure I am that if you do not possess these, you are at least, the mistress of a plant of Sollya, and this will do as well as a Billardiera for the purpose of studying the characters of the PITTOSPORUM tribe to which they both belong.

Sollya heterophylla (Plate XXVIII. 1.) is a little evergreen climbing plant, with light-green, alternate, oval, shining leaves, most of which have an even edge, but a few are, now and then, serrated; there are no stipules, and the leaves have a slight odour of turpentine when rubbed. The flowers grow in small nodding cymes or clusters, are bell-shaped, and of a beautiful bright blue, not unlike that of our own wild *blue-bells* (Hyacinthus non scriptus). The flower-stalks are slender, and have each a tiny awl-shaped bract at the base. The

calyx consists of five narrow sharp sepals (*fig.* 3. *a.*), within which arise the ovate petals. There are five stamens alternate with the petals, and growing from below the ovary (*fig.* 3. *b.*), with narrow yellow anthers, converging into a cone that surrounds the style, and opening by two pores at the point (*fig.* 4). The ovary is a slender downy body (*fig.* 5.), furrowed with deep channels, narrowed into a smooth white style (*fig.* 3. *c.*) ending in a small two-lobed stigma, and containing two cells (*fig.* 6.), in each of which are two rows of ovules attached to the placenta by long slender stalks; these ovules are separated from each other by thin green horizontal plates. The beauty of Sollya lies entirely in its flower; its fruit is not rich and tempting in appearance like that of Billardiera, but an oblong, hard, hairy brownish body (*fig.* 2 & 7.), tipped by the hardened style, If you cut across it you will find it apparently separated internally into four cells; but this is a deception, arising from the matter that lines the inside of the ovary having grown up between the ovules so as to lodge them all in distinct cells; this is most evident when the fruit is cut lengthwise (*fig.* 7.), when every one of the little brown seeds is seen nestling in its own close box. The seeds have a minutely rough skin (*fig.* 8.), and retain the stalk you saw on them when ovules (*fig.* 8. *a.*). If you open them skilfully they will be found to consist of some hard brownish albumen, in which a very small embryo (*fig.* 9. *a.*) is lodged near the hilum.

At first sight a plant like this appears very unlike a Vine; but if the two are botanically contrasted, it

will be obvious enough that they are in fact very nearly related. Sollya and Billardiera climb; so do Vines; they have all alternate leaves without stipules, their stamens are 5, their petals 5, their ovary superior and two-celled, their embryo a minute body lying in albumen; and the Vine and Billardiera agree in having soft fruit, not that that is of much importance. These points of resemblance are so numerous, among the most important parts of the structure, as to render the relationship of the tribe before us and Vines unquestionable. They differ, however, too much to be actually included in the same tribe; for these plants have not stamens opposite the petals, nor erect seeds, nor glands below the ovary, all which are distinctive marks of the Vine tribe. They have therefore been collected into an assemblage called the PITTOSPORUM TRIBE, after a genus of which no mention has as yet been made, and which you do not often meet with in gardens. Its species are very different in habit from Sollya and Billardiera, being upright evergreen bushes, and not climbers, and having a capsule that opens into valves, and not a soft berry. The most common of the genus is the *Tobira Tree* (Pittisporum Tobira), an evergreen laurel-like bush, with cream-coloured sweet-scented flowers. It is not rare in extensive collections, and in some warm situations will even grow in the open air without protection in the winter. Nothing can be more unlike a Vine than Pittosporum itself; but it is so closely allied to Sollya, which is next akin to Billardiera, the affinity of which to the Vine has been demonstrated.

The last case has served to shew you another instance, in addition to those you are already acquainted with, of plants, apparently very dissimilar, being in reality near relations, and that it is only to Botanists that the links which hold together, what is, not very correctly, called the mighty chain of the creation, are perceptible. It will not be uninteresting to take this opportunity of making you acquainted with a highly curious natural order, which, with far more apparent resemblance to the Pittosporum tribe than the Vine, has in reality a much more distant relationship.

On heaths, and sunny knolls, and on many a naked down all over England, is found a pretty little herb, with exquisitely curious tiny blossoms of blue, or white, or pink, which modestly peep up from the turf that cherishes them. They call it MILKWORT (*Plate* XXVIII. 2.). The ancients fancied that it, or some such plant, possessed the property of increasing the quantity of milk in the cows that fed upon it; hence its name. One never sees it cultivated in gardens, and yet it is of an exceedingly beautiful, and most curious structure; but its flowers are so small that all which is most admirable in it is overlooked by the incurious observer, and larger foreign species, chiefly from the Cape of Good Hope, are nursed in greenhouses in its room. Our Milkwort (Polygala vulgaris), has weak rambling stems from two to eight inches long, clothed with minute, oval, sharp-pointed, deep green leaves, and terminated by a short raceme of flowers. These have so very uncommon a form that I must describe them more particularly than usual.

Separate a single flower from the others (*fig.* 2.). At the base of its stalk grow three little scale-like bracts, of a pale delicate lilac colour, like the stalk itself (*fig.* 2. *a.*). The calyx has five sepals—"Five?" you will say, "I see but three."—The calyx *has* five sepals, of which three are small, green, and narrow (*fig.* 2. *b. b.*), and two broad, bright blue, and spreading away from the flower like wings (*fig.* 2. *c. c.*) You no doubt mistook the last for petals, because they were delicate in texture and rich in colour; but it is not such qualities that constitute a calyx, as you have long since been aware; a calyx is merely the outer row or whorl of leaves, and you will find that the two blue wings of the Milkwort grow from between the green sepals out of a row (*fig.* 2.), which, although a little broken, evidently belongs to one whorl.

Now it is a general rule that whatever number of sepals there may be in a flower, there will be the same number of petals, if there are any at all; and although no doubt we have exceptions to this, yet such is the rule in most cases. The Milkwort looks as if it were one of the exceptions, for upon examining its corolla, the greatest number of parts you seem able to make out is three (*fig.* 3. *b. b. c.*). Strip off the sepals, noting carefully the spots from which they separate (*fig.* 3. *a.*); you will then have a corolla with two erect, lanceolate, blue segments (*fig.* 3. *b. b.*), and a sort of fringed protection in front of them (*fig.* 3. *c.*), called the crest; this is but three parts. Let us, however, examine the beautiful little crest a little more particularly, for which purpose we will cut it off the

back petals, and look at its inside (*fig.* 4.); we shall then find that it is a light blue, downy plate, divided at the point into two parcels of fringe (*fig.* 4. *c.* & *c. c.*) within which there is a little hood (*fig.* 4. *b. b.*), having the most delicate little whiskers in the world at its base. What are the two bundles of fringe, and the little hood? they must be something similar in nature to what is found in other flowers, although strangely disguised. Botanists say that the hood is the point of the middle petal of three, and that it has the two side petals with their fringes firmly attached to its back, so that the crest is in reality made up of three petals naturally soldered together, and these, together with the two other petals at the back, make up the number five of which we have been in search.

But where are the stamens of this curious plant? Not at the base of the ovary (*fig.* 7.), nor attached to the calyx, nor any where within sight. Lift up or press back the hood we have been talking of, and there you will find them. There are two rows of little yellow cases hidden beneath this hood (*fig.* 4. *b.*), four cases in each row, and adhering to a thin membranous plate (*fig.* 5. *a.*); the latter is the united filaments, and the cases are the anthers. Why they thus lie perdu beneath the hood in the inside of the crest you will perceive presently; in the mean while observe that each anther not only opens by a pore at the point, (*fig.* 6.) but is one-celled. The ovary (*fig.* 7.) is an oblong body, containing two cells, in each of which is one pendulous ovule (*fig.* 8.); it is furnished with a club-shaped style, and a thick two-lipped stigma, the

upper lip of which (*fig.* 7. *c.*) is purple, large, and hooded, the lower (*fig.* 7. *b.*) small, flat, yellow, and bent downwards. All the parts of the flower are so placed about the stigma, pressing upon it, that there is no room for insects, or even wind, to insinuate themselves for the purpose of dispersing the pollen; on that account the stigma fronts the hood under which the anthers are hidden, and, opening its wide mouth, (for surely that may be called wide, the two lips of which are so far apart as in this plant (*c.* & *b. in fig.* 7.),) gapes to receive the pollen, which easily falls into it when the anthers open. The fruit is a heart-shaped capsule (*fig.* 9.), opening through the middle of the cells, and allowing two pendulous seeds to fall out. The latter (*fig.* 10.) are small, oblong, dark brown, hairy bodies, at the hilum of which there is a curious white hairy lobe, or *caruncula* (*fig.* 10. 11. *a.*). They contain a large, flat, dicotyledonous embryo, lying in a small quantity of albumen (*fig.* 11.).

The Milkwort Tribe obviously differs in so many respects from the Pittosporum Tribe that it would be tedious and unnecessary to recount them. Neither is there any other assemblage of plants sufficiently similar to be mistaken for them, unless it is the Pea Tribe (Letter VIII.), and with that students do sometimes confound them, because of the resemblance that the flowers of the Milkwort appear to bear to what are called papilionaceous. If, however, they are attentively considered they will be found not to resemble them in reality, for the two wings, which might be mistaken for the wings of a papilionaceous

flower, belong to the calyx and not to the corolla, which is a most important difference.

Many a plant belonging to the Milkwort tribe grows wild in the southern parts of Europe, and at the Cape of Good Hope; nor are species altogether wanting in any quarter of the globe. The Cape kinds are, as I have already told you, often cultivated in Greenhouses, of which they are a great ornament. Generally these plants are bitter; but some of them abound to such a degree in saponaceous properties as to be real vegetable *blanchisseuses*. There is, in particular, a plant in Peru, called *Yallhoy* (Monnina polystachya), an infusion of whose bark is used by the ladies of that country for washing their beautiful hair, and finer is that hair said to be than any other in the world. This I am not so unjust as to believe; but the mere statement, with all its exaggeration, suffices to shew that the plant in question possesses properties of no common kind.

EXPLANATION OF PLATE XXVIII.

I. The Pittosporum Tribe.—1. A twig of *Sollya heterophylla*, or *the various-leaved Sollya*, in flower.—2. A small cluster of its fruit.—3. A calyx magnified, with the stamens coverging in a cone around the style; *a* the sepals, *b* the anthers, *c* the style.—4. A set of the stamens curved back, and opened out; *a* the pores by which the anthers discharge their pollen.—5. An ovary.—6. The ovary cut across transversely, exhibiting the ovules lying in the two cells, and the ten ridges of hair that clothe the surface of the ovary.—7. A longitudinal section of a ripe fruit, shewing how the seeds are lodged in separate hollows, produced by the growing up of the sides of the ovary.—8. A seed, with its stalk or funiculus, *a*.—9. A section of the same, with the

embryó, *a*, lying in discoloured albumen.—10. An embryo very much magnified.

II. The Milkwort Tribe.—1. A twig of *common Milkwort* (Polygala vulgaris).—2. A complete flower much magnified; *a* the bracts, *b b* the small sepals, *c c* the petaloid sepals, *d d* the back petals, *e* the crest.—3. A corolla from which the sepals have been removed; *a* the scars from which the sepals have been taken, *b b* the back petals, *c* the crest, *d* the hood lying within the pouch.—4. A portion of the crest very much magnified, and seen from the inside; *a* the hood or middle petal, *b b* the stamens, *c* one set of fringes, or one of the side petals, *c c* the other set of fringes, or side petal, *d d* the hairs on the inside of the crest.—5. One of the two parcels of stamens, *a* the filament, *b* the anthers.—6. An anther.—7. An ovary, with the style *a*, and the stigma *b c*.—8. A longitudinal section of the ovary, shewing the two pendulous ovules.—9. A ripe capsule, opening and exposing its seeds *a a*, between the valves *b b*.—10. A seed; *a*, its caruncula.—11. The same cut lengthwise, shewing the embryo *b*, and the caruncula *a*.

LETTER XXIX.

THE MIGNONETTE TRIBE—DISK—THE CAPER TRIBE.

Plate XXIX.

ONE of the first flowers that we learn to gather—the very last that we cease to value—is Mignonette, that simple, unattractive weed, which is the envy of the gay and glittering throng that surrounds it in a garden, and which has no rivalry to dread, except from the Rose and the Violet. We are delighted with its fragrance, but we seldom think of asking whether, beneath the green and brown colours of its flowers there may not lurk some hidden beauties equally deserving of admiration. It is one of the advantages of Botany, that it of necessity leads us to such inquiries. Let us look into its history and structure.

Mignonette (Reseda odorata) is generally reputed to be a native of Egypt and Barbary; but the only certain station for it is in the sandy country about Mascara, a fortified town of Algiers; writers on the Botany of Egypt make no mention of it. We find it in our gardens to be annual, sowing its seeds spontaneously, and springing up year after year wherever it has once been cultivated; but in reality it is a half-shrubby plant, like a wall-flower, and will live a long while, if protected from cold in the winter. I once

The Mignonette Tribe. XXIX. 1.

Mignonette.

The Caper Tribe. XXIX. 2.

Prickly Caper.

knew of a plant which had established itself in a crevice at the top of the back-wall in the inside of a greenhouse, just beneath the glass roof; it remained growing in that situation for some years, putting forth its odoriferous flowers the whole winter long; and it had become quite a bush at the time when it was destroyed by an accident.

In the leaves of Mignonette there is nothing sufficiently remarkable to point out; but the flowers are exceedingly curious. They grow in racemes (*Plate* XXIX. 1. *fig.* 1.), on longish stalks, from the bosom of little green bracts. Each consists externally of a calyx, composed of six, linear, green sepals (*fig.* 2. *a. a.*), of equal size, and rather shorter than the petals. The latter are also six in number, but very unequal in size and dissimilar in form; the largest (*fig.* 2. *b.* and *fig.* 3.) are green, fleshy, wedge-shaped bodies, bordered with unequal, whitish, gland-like hairs, and having at the upper end a crest, consisting of white, flat threads, which are broader at the upper than the lower end. The smallest petals are roundish, and much shorter than their crest-like appendage, which, moreover, is made up of much fewer parts than that of the largest petals. From within the base of the petals there rises a short green stalk (*fig.* 6. *a.* and *fig.* 4. *a.*), called the gynophore, from the top of which springs a one-sided, brown, hairy lobe, or *disk* (*fig.* 4. *b.* and *fig.* 6. *b.*); hollowed out into a short tube at the bottom, where it surrounds the base of the ovary, and bearing twelve stamens at the top of the tube (*fig.* 4.).

Before we proceed further, let me detain you a moment with the meaning of the word DISK: a term that has just occurred. We formerly had it as the name of the central part of a compound or rather a composite flower, (Vol. I. p. 203.), comprehending all the florets which have a tubular structure with an equally divided border; in the present instance it is used in a different sense. It means a supernumerary organ, different from the stamens or petals, and originating at the base of one or other of them. Nothing can well be more variable in its nature than this disk; in the Mignonette it is, as you see, a one-sided, hairy lobe; in some plants it is a fleshy ring surrounding the ovary; in others a small number of glands in the same place; in Black Horehound you formerly saw it in the state of a green fleshy base to the lobed ovary (Vol. I. *Plate* XVI. 1. *fig.* 4. *a.* and 6. *a.*); and in the poppy-flowered Pæony you will find it constituting a deep purple case, enveloping the ovaries, and cut into irregular segments at its edge. In all these instances the disk is considered to be in reality either corolla, or stamens, in a disguised state; in the example before us, it is to be referred to the corolla.

The ovary of the Mignonette (*fig.* 6.) is an oblong, three-cornered, three-horned, one-celled case, having its horns terminated by the stigmas, and its ovules arranged in triple rows upon three narrow placentæ (*fig.* 7. *a. a.*), corresponding with the principal angles of the ovary. If viewed with a magnifying glass, the

angles will be found covered with a cold-grey frost, of an extremely pretty appearance.

The seed-vessel of the Mignonette is an oblong brown case (*fig.* 8.), opening at the point into a triangular passage, through which the seeds readily fall out. The seeds (*fig.* 9.) are brown, warted, kidney-shaped bodies, attached by the middle of their concave side (*fig.* 9. *a.*), and contain an embryo, which is curved like the seed itself (*fig.* 10.).

Besides Mignonette, the genus Reseda contains many other species; they are all, however, confined, when cultivated, to Botanic Gardens; for they are but little superior in external appearance to the Mignonette itself, and they have none of its fragrance. Two of the species are wild in Great Britain, and one of them (Reseda luteola), the *dyer's weld*, possesses the property of imparting a beautiful yellow colour to linen and wool.

You have remarked, that in Mignonette the ovules grow to the shell of the ovary, and not to the middle; a similar circumstance has been pointed out to you in the tribes of the Violet, the Poppy, the Passion-flower, and others, formally brought under your notice. I think I have somewhere already told you that the place where the ovules adhere to the ovary is called the *placenta*; and that the manner in which they adhere is hence called their *placentation*; let me now add, that when the placentæ are upon the shell of the ovary, as in this and the other instances already alluded to, the placentation is technically called *parietal*; I mention this, because the latter term is of such com-

mon occurrence that Botanists are obliged to have recourse to it frequently. You will understand this readily enough if you compare with each other *Plates* 1. 2. *fig.* 6.; IV. 2. *fig.* 6.; and V. 1. *fig.* 4.

Should you now seek to discover some tribe of plants with which the Mignonette can be identified, you would undoubtedly fail, for it is extremely unlike any of those hitherto mentioned to you by me. On this account it forms a group by itself, called Resedaceæ, or the MIGNONETTE TRIBE. There are, however, plants allied to it by many important characters, the most interesting being what are popularly called Capers. We will now investigate their structure.

The CAPER TRIBE (Capparidaceæ), may be considered as represented by that species which furnishes the Capers sold by the Italian oil-men. This plant (Capparis spinosa, *Plate* XXIX. 2.) inhabits the chalk and volcanic rocks of the South of Italy and Sicily, especially those within the influence of the sea; there it enjoys a bright warm summer and a mild and equable winter, and trailing over the precipices that it inhabits, gives to the wild and rugged scenery a summer charm which the Myrtle and the Rock-rose in vain attempt to emulate. Wherever a similar climate can be found, the Caper bush is transferred for cultivation, on account of the mild, agreeably pungent properties of its flower-buds. It is these which form the Capers of the shops, their quality depending upon the age at which they have been collected; the youngest, and consequently the smallest, forming samples of the best,

and the largest and oldest of the worst quality. But let us examine the Caper plant more systematically.

It is an undershrub, with long, smooth, shining, trailing, purple branches, bearing alternate, ovate, flat dull green leaves, edged with purple, and placed upon a short purple stalk. At the base of the stalk, on each side, is a short straight spine, supposed to be a disguised stipule. From the axils of the leaves the flowers (*fig.* 1.) grow singly, on hard, smooth, purple stalks. They have four, spreading, oblong, obtuse, concave sepals; four white petals, notched at the end, downy at their base, and so placed that two adhere to each other, as if really united; there is a large number of stamens growing from the base of a central column, with thread-shaped filaments; and, finally, the ovary (*fig.* 1. *b.*) is an oval purple case, growing on the end of a long cylindrical gynophore (*fig.* 1. *a.*). The interior of the ovary (*fig.* 5.) is very like that of the poppy (*Plate* I. 2. *fig* 6.), having several plates covered with ovules, projecting from the shell, and not meeting in the middle: the placentation being therefore parietal. The stigma is a roundish, sessile, purple tip of the ovary (*fig.* 4. *d.*). At the base of the gynophore, on one side of a sort of cushion that bears the stamens, is a small, ovate, convex, gland-like disk (*fig.* 4. *a.*). When the fruit is ripe it becomes an oblong, knobby body (*fig.* 6.), filled with firm pulp, within which the seeds lie in as many rows as there previously were placentæ. The seeds themselves are very like those of Mignonette, only smooth, not warted.

I have already said that the Capers of the shops are

the unexpanded flower-buds of this plant (*fig.* 2.). If you cut them across you will find their appearance in a transverse section sufficiently curious. They consist of several green leaves wrapped one over the other (*fig.* 3.), and enclosed within a couple of concave bracts; within these lie the petals, enwrapping the stamens, which are closely packed round either the gynophore or the ovary.

Our gardens contain nothing included in the same group as the Caper, except certain annuals called Cleomes, a few of which have gay starry flowers, and long stamens, far less numerous than in the Caper itself.

It is obvious that this plant accords with the Mignonette tribe more than any others yet examined. It has, independently of its polypetalous flowers, a considerable number of stamens, a disk adhering to the part in which the stamens originate, a gynophore on which the ovary is elevated, an ovary with parietal placentation, and kidney-shaped seeds, with a curved dicotyledonous embryo. These circumstances undoubtedly indicate a near alliance between the Caper and Mignonette, and in reality, the general opinion now seems to be in favour of their standing next each other, only in distinct groups.

With regard to *Cleomes*, I must refer you to the Hothouse for information concerning them. They are considered to stand, as it were, between the Caper tribe and the Cruciferous tribe (Vol. I. *p.* 55.); connecting, in a very conspicuous manner, plants that otherwise would not have been readily brought near each other.

EXPLANATION OF PLATE XXIX

I. The Mignonette Tribe. — A few flowers of Mignonette *(Reseda odorata)*.—2. A perfect flower magnified; *a a* sepals; *b* the upper and larger petals, with their crested appendages.—3. One of the upper petals still more magnified.—4. A flower with its sepals and petals cut off, shewing at *a* the gynophore, and at *b* the disk, with the stamens and ovary within them.—5. The upper end of a filament with its anther.—6. A view of the young ovary, when the petals and stamens have dropped off; *a* the gynophore, *b* the disk.—7. A transverse section of the ovary, with the ovules adhering in triple rows to the three parietal placentæ.—8. A ripe fruit, opening by a triangular passage, *b*, at the apex, and having the remains of the disk, *a*, adhering to its base.—9. A ripe seed; *a* the scar.—10. A longitudinal section of the same, with the dicotyledonous embryo; *a* the scar.

II. The Caper Tribe. — 1. A twig of the prickly Caper *(Capparis spinosa)* in flower; *a* the gynophore; *b* the ovary, *c c* the spiny stipules.—2. A young flower-bud, in the state in which it is gathered for pickling.—3. A transverse section of the same, magnified.—4. A view of *a* the disk, *b* the gynophore, *c* the ovary, *d* the stigma, *e* the receptacle of the stamens magnified.—5. A transverse section of the ovary, with the ovules adhering to the plate-like parietal placentæ.—6. A portion of a ripe fruit cut across.—7. A ripe seed; *a* the scar.—8. An embryo extracted from the seed.

LETTER XXX.

THE CACTUS TRIBE—THE GOURD TRIBE.

Plate XXX.

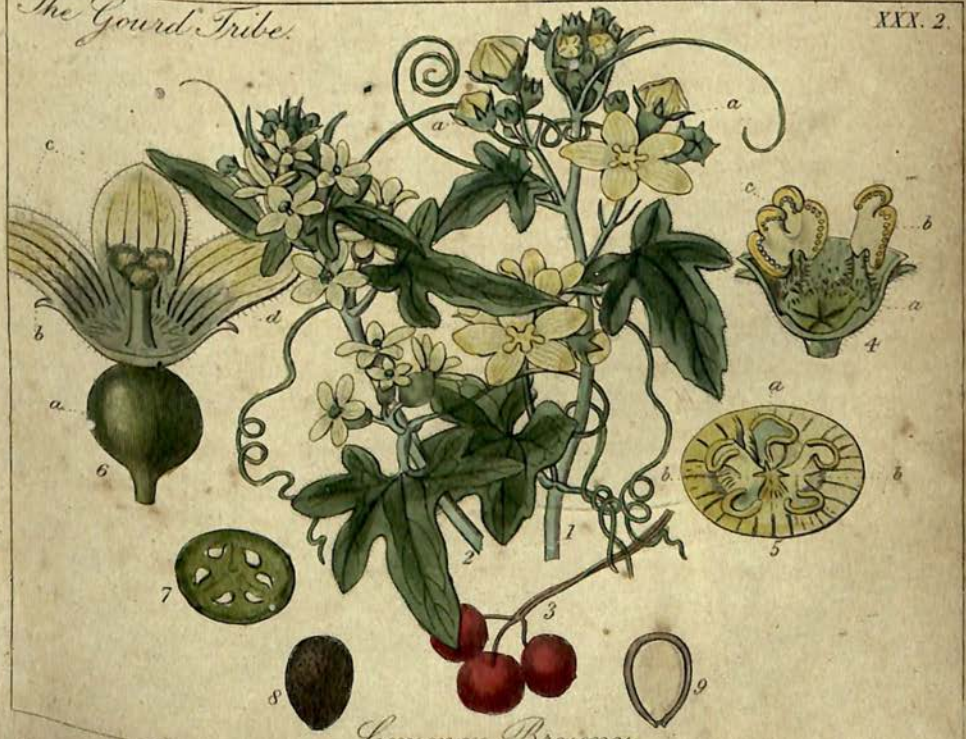
Besides the plants spoken of in my last letter, there are several others whose placentation is also parietal (see page 39.), and it will be better, before we proceed to other subjects, to examine some of them; especially two which are of very common occurrence.

The plants called Cactuses, which, from the profusion of large richly-coloured flowers that some species are loaded with, have given to our conservatories an air of magnificence which was quite unknown till of late years, constitute the small group of Cactaceæ. The species are in all cases succulent, and with the single exception of the Pereskias, destitute of leaves, in whose room the stem is either green and leaf-like, or at least covered over with a green integument, which has the structure of the pulpy part of the leaf, and like it executes the office of respiration. You will form a general idea of this highly curious natural order when you are told that the plants called *Indian Figs* (Opuntia), with their prickly, jointed, flattened stems, on which the Cochineal insect feeds; *Torch-thistles* (various species of Cereus), whose angular trunks rise erect and singly into the air, like fantastic vegetable

The Cactus Tribe. XXX. 1.

Shenry Cactus.

The Gourd Tribe. XXX. 2.



Common Bryony.

columns; *creeping Cereuses*, with their long pendant branches, which might be taken for the tails of some animal, if it were not for the gay, rose-coloured flowers they push out from time to time; and all the strange races of *Melon-thistles* (Melocacti), *Porcupine-thistles* (Echinocacti), and *Hedge-hog thistles* (Mammillarias), whose names sufficiently attest their extraordinary appearance—I say, you will form a clear general idea of this curious Cactus tribe, when you have collected in your mind all the remarkable plants that have now been named; and I cannot anticipate any difficulty in your doing so, because they are among the commonest plants that inhabit greenhouses. All these species are destitute of true leaves, except when they are first beginning to grow. Just at that time they do indeed produce little succulent bodies, which we know to be rudiments of leaves: but such parts drop off soon after they are born, and the only representatives they leave behind are the stiff, hooked spines, with which so many species are covered. The parts which are mistaken for leaves in the Indian fig, or some of the more common species of Cereus, are only the flattened joints of the stem.

It would be difficult to find any race of plants, where a more obvious connection exists between the manner in which they are constructed and the situations it is their destiny to live in. The greater number grow in hot, dry, rocky places, where they are exposed for many months in the year to the fiercest beams of a tropical sun, without a possibility of obtaining from the parched and hardened soil,

more than the most scanty supply of necessary food. Under such circumstances plants of an ordinary structure would perish; but Cactuses have a special power of resisting heat and drought, and, like the Camel, they carry with them a supply of water for many, not days, but months. It usually happens that once a year, during several weeks at least, the air that surrounds them is saturated with moisture, and the soil they live in is drenched by ceaseless rains. At this time they grow fast, all the little cavities in their tissue, of which there are countless millions, are filled with liquid nourishment, and they may be literally said to gorge themselves with food. Then, when the rains cease, and the air dries up, and the Spirit of the desert reassumes his withering dominion over their climate, Cactuses are in the most robust health, and their cells are abundantly filled with provision against scarcity. But these supplies would be quickly consumed by plants only protected by a thin cuticle, and having their surface pierced by millions of breathing pores, all actively exhaling the evaporable matter that lies beneath them, and an early death would be the inevitable result. Such, indeed, is the lot of all the gay companions of the Cactus, which surrounded it during the season of feasting and prosperity, and to which Nature has given no special means of enduring the hardships to which their lot exposes them; a few days or weeks suffice to sweep their forms from the face of the creation; their leaves rapidly consume the stores deposited in their stems, their stems turn in vain to the roots for a renewed supply, for after but a little

while the arid earth has nothing to part with, and then the leaves wither and fall off, the stems shrink up and crack with the dry heat, and the roots themselves, in many cases, follow the same fate. With Cactuses this is different ; they have so tough and thick a hide that what liquid substances they contain can only pass through it in minute quantities; the breathing pores of their surface are comparatively few, and so small as to act with extreme slowness when the air is dry; so that in proportion to the aridity of the air, and the heat to which such plants are exposed, is their reluctance to part with the food they contain. They digest and re-digest it, with extreme slowness, and may be truly said to live upon themselves during all those months when they cannot feed upon the soil or the atmosphere.

This statement applies more particularly to the species consisting of solid fleshy masses, like the Melon-thistles, the Hedgehog-thistles, and the like; but requires to be modified with reference to the thinner-stemmed species, such as Cactus speciosus, speciosissimus, and truncatus; of them it is equally true, but in a less degree.

The property which the Cactuses thus possess of living where few other plants can exist, sometimes renders them of great utility to man. On Mount Ætna, for instance, and its volcanic fields, it is the *Indian Fig* (Opuntia) which the Sicilians employ to render such desolate regions susceptible of cultivation. This plant readily strikes into the fissures of the lava, and soon, by extending the ramifications of its roots

into every crevice of the stone, and bursting the largest blocks asunder by their gradual increase, makes it capable of being worked.

You will now be curious to know by what botanical characters these interesting plants are certainly known. To the tufted spines that are scattered over the stem, instead of leaves, I have already adverted. The flowers are the next part for us to study; and here you are at last introduced to the most highly developed, the most complicated, the largest, and the most richly coloured, or purely colourless, of all the blossoms in the Vegetable Kingdom. The *Showy Cactus* (Cereus speciosus) is at hand; by no means the handsomest or the largest of this glorious tribe, but one that shews as well as any other the nature of its organization (*Plate* XXX.). In the flower of this species, you will seek in vain for a distinction between the calyx and corolla. It has a cylindrical stalk (*fig.* 1.), the lower part of which (*a.*) is hollowed out of the ovary, and the upper portion covered with small scale-like rose-coloured bracts (*a. a.*), which gradually pass into large, thin, delicate leaves of the same colour, unfolding tier upon tier from within each other, and adhering by their lower ends, till a fleshy firm tube (*fig.* 4. *b.* & *fig.* 2. *a.*) is produced. About the middle of this tube, just where it swells out and ceases to be cylindrical (*fig.* 4. *c.*), springs forth a multitude of slender stamens (*fig.* 2. *b.*), placed row within row upon the tube, and forming a long, white, filamentous cylinder or cone. The ovary is, as you have already been told, a cavity in the bottom of the apparent stalk of

the flower (*fig.* 4. *a.*); it contains a great number of young seeds, attached to the lining of the cavity, in eight rows, or placentæ, each hanging from the point of a long slender thread (*fig.* 5). The style rises like a graceful column (*fig.* 4. *d.*), from the top of the ovary, and after reaching a little beyond the limb of the anthers, divides into eight short, narrow, fringed arms, forming a beautiful star of eight rays. After a few days, or even hours, all this gorgeous panoply fades away, the stamens wither, the starry stigma closes its rays, and the style, no longer able to support it, curves downwards beneath its weight; the floral leaves droop, their colours become deadened, their firmness and elasticity are replaced by a soft and slimy ooze, and quickly afterwards the whole of this once lovely apparatus is thrown off by the ovary, which enlarges, becomes pulpy, acquires a new colour, matures its small brown seeds, and finally becomes a fruit so similar to that of a Gooseberry, that for a long time the latter and the Cactus were thought to be related. Its seeds contain an embryo (*fig.* 6. & 7.) coiled up in the shell, which accurately fits it, and having a long slender radicle, with two distinct cotyledons. This kind of structure, however, is not universal in the Cactus Tribe. It sometimes happens that the embryo is straight, and almost destitute of cotyledons, their presence being only indicated by a little notch in the end of the embryo (*fig.* 10. 11.). This unusual circumstance is interesting, as shewing that the habit of growing without leaves is not confined to the stem, but is to be met with, in some species, even in the embryo itself.

I have said that the fruit of the Cactus bears a strong resemblance to a Gooseberry; the similarity is not confined to the appearance, but extends to the flavour, texture, and quality. So wholesome, indeed, is the Cactus fruit, that it is an important object of cultivation in some countries. On Ætna, for example, the large cooling fruits of the Indian Fig are sold in considerable quantity, and some of the varieties are found of great excellence. In the West Indies, and South America, Cactus fruit is often consumed as Gooseberries.

Perhaps there are few plants more resplendently beautiful than the *Showy Cactus*, when covered, as it often is, with hundreds of its large rosy blossoms. But there are many species far more magnificent in their individual flowers; as for instance, all those called *night-blowing Cereuses* (C. grandiflorus, triangularis, Lanceanus, Napoleonis), with their large trumpet-shaped tubes, cut at the border into starry segments of the most dazzling white, the purity of which is increased by the tassel of pale yellow stamens that occupies their centre, and also by the extraordinary contrast of the beautiful flowers, and the misshapen, dingy, snake-like, leafless stems from which they spring. Many of the *Porcupine thistles* too, especially Echinocactus Eyriesii, partake of the same noble features; and as they have the property of flowering by day, they are the more valued as well as better known.

These particulars will make you as familiar with the Botanical history of Cactuses, as you perhaps already are with their general properties.

It may seem like a paradox at once to proceed from such plants as these, to melons, gourds, and Cucumbers, because of their natural affinity, especially if *Bryony* (Bryonia dioica, *Plate* XXX. 2.) be taken by way of illustration. And yet such is the course I must follow ; for I know of no plants allied to Cactuses in so many respects as the GOURD Tribe is. This will be more evident presently.

That the various kinds of *Gourd, Vegetable Marrow, Squash,* and the *Melon, Water Melon,* and *Cucumber,* are all combined by characters of the strictest resemblance, requires no proof. Nor indeed is it possible to doubt that the Bryony (*Plate* XXX. 2.) also appertains to the same group. I shall leave you to examine the former without my assistance; the last mentioned plant deserves a detailed notice. You are, perhaps, aware that it is a perennial plant, with a large fleshy poisonous root, and rough stems, that rapidly extend over bushes and hedges, adhering firmly to the branches by means of its tough and numerous tendrils. In Norfolk, Suffolk, and many other parts of England, it is abundant in hedge-rows, half smothering the bushes it clings to, and reddening all the lanes with its clusters of scarlet berries.

It bears the rough, pale yellow, toothed leaves of the Gourd, but they are differently lobed and formed, for they have about five deep divisions, of which that in the middle is rather longer than those at the sides, while the lowest are often two-lobed, and always turned back upon the stalk, so as to give the leaf what is called a heart-shaped base. The flowers are

in the technical terms of Botanists called dicœcious; that is to say, those which contain the ovary and stigma grow on one plant, and those with the stamens grow on another plant. I must speak to you of these two separately.

The flowers with stamens (*Plate* XXX. 2. *fig.* 1.) have a green cupped calyx, with five little teeth (*fig.* 1. *a. a*), and a light-green strongly veined corolla of five petals, forming part with the calyx so completely, that the whole has the appearance of one five-lobed calyx. The stamens are five in number (*fig.* 4.), they have no filament, but consist of a fleshy, lobed, or sinuous connective (*fig.* 4. *b.*), bordered by the narrow pollen-bearing cells of the anther, which are separated from the connective by a glittering row of little prominent glands, placed like a fairy necklace. Ovary there is none.

The flowers with a pistil, so far as the calyx and corolla are concerned, are like those containing the stamens, only smaller, and in closer clusters, with shorter stalks (*fig.* 2.). They do not contain a trace of stamens, but have an inferior, dark green, round, ovary (*fig.* 6. *a.*), ending in a short, stiff, round style, divided into three cushion-shaped stigmas (*fig.* 6. *d.*). When opened, the ovary contains some ovules, attached in double rows to three parietal placentæ (see p. 39), and is nearly filled up by a firm fleshy substance (*fig.* 7.). The fruit becomes a round, scarlet, pulpy berry (*fig.* 3.), containing two or three flat, brown, hard seeds (*fig.* 8. 9.).

If you compare what has now been described with

the structure of a Gourd, you will find that the principal differences are as follows. The Gourd has larger leaves and flowers, the latter being yellow; the sterile and fertile flowers both grow on the same plant; the anthers adhere together a little, and stand parallel with each other; the stigmas are two-lobed; and the fruit is a large seed-vessel, pulpy inside, but having a hard rind externally, and containing a great multitude of seeds. And if you examine others of the plants already named, you will see that the differences are of a similar description.

The most curious plants of the Gourd Tribe are the *Bottle Gourd* (Cucurbita lagenaria), which is fashioned like a flask, and the inside being removed is actually used as a water bottle, the *Snake Cucumber* (Momordica cylindrica), whose slender cucumber-like fruits are many feet long, and curved and twisted like a vegetable snake, and the *Spirting Cucumber* (Momordica Elaterium), the seeds of which are ejected with violence when the fruit-stalk is suddenly removed.

You will now say, "I perceive the resemblance between all the plants you have named to me, and I understand their structure, but how do you show an affinity between the Gourd Tribe and the Cactus Tribe?" That is the next point.

In the first place, remember that the flowers of Cactuses are not always large and manifold in structure, but sometimes very small, and the parts far from numerous; secondly, that, as I have long since said (Vol. I. p. 105), the succulent character of Cactuses is not peculiar, but common to them with many others,

and is hardly a mark of affinity, but rather a specific quality; thirdly, that many Cactuses are climbing plants, although they have no tendrils. These points being settled, remark in the next place, that both Cactuses and Gourds have succulent fruit; that their seeds are numerous, and attached to the sides of the fruit; that they have no albumen; and that there is hardly more difference between the calyx and corolla of the one than of the other; that is to say, that they are in both cases very similar to each other in appearance; moreover, that in each tribe the stamens grow from the sides of the calyx-tube, and the ovary is inferior. The resemblances are sufficient to show that the two tribes are allied to each other in no very distant degree, although they do not prove them to stand in immediate contact. But I have not asserted that such was the case; in fact, the most direct affinity of the Gourd is perhaps with the Passion-flower Tribe, as has been stated on a former occasion (Vol. I. p. 71.). From those plants, however, the Gourd Tribe deviates in many important particulars, so that, in reality, there is no known natural assemblage that they immediately impinge upon.

EXPLANATION OF PLATE XXX.

1. The Cactus Tribe.—1. A flower of Cereus speciosus, the natural size; *a a* the bracts; *b* the ovary.—2. The stamens, magnified, with a portion of the tube of the flower at *a*; *b* the filaments; *c* the starry stigma.—3. An anther, with a portion of a filament adhering to it.—4. A section of a part of the tube of a flower, with the ovary at *a*,

the tube at *b*, the insertion of the stamens at *c*, and the base of the style at *d*.—5. A transverse section of the ovary, very much magnified, shewing the parietal placentation.—6. A seed of an Opuntia.—7. The embryo of the same.—8. Ripe fruit of a Mammillaria.—9. A seed.—10. A section of the same.—11. An embryo, with a notch at the end dividing the two cotyledons.

II. The Gourd Tribe.—1. A stamen-bearing twig of *Bryony* (Bryonia dioica).—2. A pistil-bearing twig of the same.—3. The ripe fruit.—4. A portion of the cup of a stamen-bearing flower, magnified; *a* the cup; *b* a single stamen; *c* a double stamen.—5. A bird's eye view of the lower part of a stamen-bearing flower, with a single anther at *a*, and two double ones at *bb*.—6. A portion of a pistil-bearing flower; *b* calyx; *c* corolla; *d* style; *a* ovary.—7. A transverse section of the ovary.—8. A seed.—9. A section of the latter, with the embryo.

LETTER XXXI.

THE BEGONIA TRIBE — THE FIG-MARIGOLD TRIBE— HYGROMETRIGAL PHENOMENA CONNECTED WITH THE DISPERSION OF SEEDS.

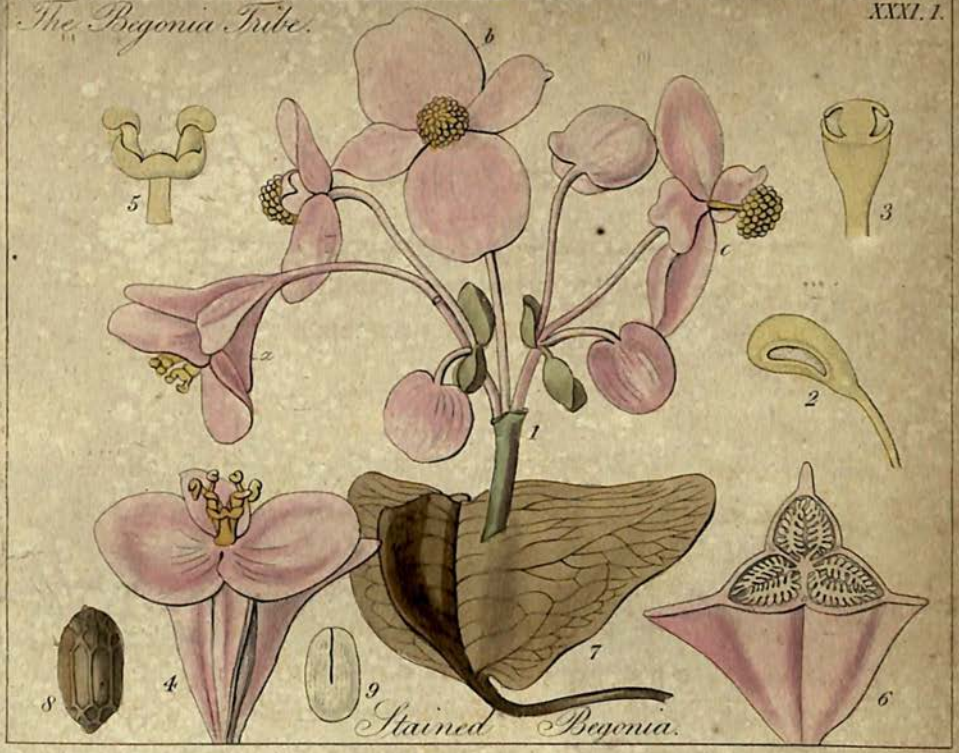
Plate XXXI.

THERE are few collections in which some one or other of the plants called Begonias are not found. They are not, however, cultivated so much for the sake of their flowers, as of their leaves, the deep rich colour of which, especially their crimson, is unrivalled in the vegetable world. These plants have in all cases one half of the leaf much smaller than the other, so that at their base they often have something the appearance of a human ear. They have a pair of large stipules at the foot of each petiole, and all the parts of vegetation are particularly tender and brittle. They grow naturally in damp tropical woods, often on rocks, or in the rifts of trees, and are among the most certain signs of a hot damp climate.

It is a matter of no little difficulty to know where to class them, or with what plants they are most naturally related; indeed, after all the consideration that Botanists have given them, the subject is still unsettled. Why this is so, you will understand, as soon as I have explained to you the structure of the fructification of Begonia.

Let the subject of examination be the commonest

The Begonia Tribe. XXXI. 1.



Stained Begonia.

The Fig Marigold Tribe. XXXI. 2.

Villets Fig Marigold.

of all the species, the *two-coloured Begonia* (B. discolor, *Plate* XXXI. 1.). The flowers of this plant grow in a kind of cyme, at the ends of the branches; each of the ramifications of the cyme has a pair of concave stipules at the base (*fig.* 1.); the flowers stand upon slender flesh-coloured stalks, and are partly sterile, partly fertile.

The sterile flowers consist of two larger obtuse pink sepals (*fig.* 1. *b.*), and two petals of the same colour. In their centre you have a round ball of anthers, the filaments of which are united into a common stalk (*fig.* 1. *c.*). The anthers are club-shaped, fleshy, yellow bodies (*fig.* 2.), having a curved pollen-cell on each side.

The fertile flowers (*fig.* 1. *a.* & *fig.* 4.) have a calyx and corolla like those of the others, only the latter has frequently but one petal. Beneath the calyx is a fleshy thick part, having three unequal wings (*fig.* 4.), divided into three cells internally (*fig.* 6.), with two plates or placentæ, covered with minute ovules, in each cell. Of course this part is the ovary; it is terminated by three stigmas, each of which (*fig.* 5.) has two twisted hairy lobes.

The fruit, when ripe, is a thin brown case, beautifully marked with deeper coloured veins, and having three wings, of which one is very much larger than the others (*fig.* 7.). It contains a multitude of small seeds (*fig.* 8.) of an oblong form, and covered with a network, the meshes of which are disposed with wonderful regularity; those at the two ends being always contracted and small, while the intermediate ones are long, with parallel sides; so that if a slice were cut off the lower end, the remainder would have quite the appearance of a gothic church window. The embryo,

which lies in the seed, is an oblong succulent mass, half split into two parts (*fig.* 9.).

In attempting to fix the natural relationship of Begonia to other plants, we need not occupy ourselves with the little resemblances it may bear to this group, or that, in one or two particulars. But, as should be done in all such cases, I will beg you to confine your attention to its more striking peculiarities, and to their conformity with what can be found elsewhere. Now what are its more striking peculiarities? They may be collected under several heads; the stamens and pistils are in different flowers; the stigmas are two-lobed; the stamens are all combined into a single column; and the anthers have a remarkably thick connective; the calyx and corolla are in twos; that is, there are two sepals and two petals; and the ovary is inferior, three-celled, with many-seeded double placentæ.

Many groups of plants can be found, in which some one of these circumstances equally exists, but it is only when two at least occur, that a comparison can be usefully instituted. For example, the Cactus Tribe has a many-seeded inferior ovary; the Myrtle Tribe, in many cases, a three-celled inferior ovary; the Mallow Tribe, the stamens combined into a column; the Maple Tribe, a winged fruit; and so on; but in all these cases the resemblance can scarcely be traced further.

The natural assemblages in which the greatest number of points of resemblance can be found with Begonias, are the Euphorbia Tribe, to be examined hereafter, the Gourd Tribe, the Evening Primrose

Tribe, and the Buckwheat Tribe. For facility of comparison, we will make a little table, in which the most remarkable characters of these natural orders shall be placed side by side with what exists in Begonia.

Begonia Tribe.	Euphorbia Tribe.	Gourd Tribe.	Evening Primrose Tribe.	Buckwheat Tribe.
Leaves alternate	Yes.	Yes.	Sometimes.	Yes.
Large membranous stipules	Yes.	No.	No.	Yes.
Stamens & pistils in different flowers	Yes.	Yes.	No.	No.
Stigmas two-lobed	Sometimes.	Sometimes.	No.	No.
Stigmas combined in a column	Sometimes.	Sometimes.	No.	No.
Anthers with a very thick connective	No.	Yes.	No.	No.
Calyx and corolla in twos	No.	No.	Sometimes.	No.
Ovary inferior	No.	Yes.	Yes.	No.
Ovary three-winged	No.	No.	No.	Yes.
Ovary three-celled	Yes.	Three Placentæ.	No.	No.
Double placentæ	No.	Yes.	No.	No.
Seeds numerous	No.	Yes.	Yes.	No.
Albumen altogether wanting	No.	Yes.	Yes.	No.
Points of agreement	6	10	5	3
Points of disagreement	7	3	8	10

This shows you that it is to the Gourd Tribe that Begonias have the nearest relation: corresponding in ten important characters out of thirteen, and that of the orders thus brought into view, the weakest affinity is with the Buckwheat Tribe, or only as three to thirteen, and of those three characters, two are of the lowest importance. Indeed, I should not have thought it worth including the latter in the comparison, if it had not been the opinion of the learned Jussieu, that Begonias and the Buckwheats are related.

While, however, after an investigation of this nature, it is difficult to refuse assent to the placing Begonias and the Gourds near each other in the system, it is nevertheless obvious enough, that they are not so closely allied, as to deserve being considered contiguous groups; and it is highly probable that plants have still to be discovered, of an intermediate character by means of which the two assemblages will be connected.

Before I dismiss the subject of Cactuses, and the orders allied to them, it is necessary that I should say a few words upon the Fig-Marigold Tribe, an assemblage of plants of remarkable beauty, although but little cultivated now, in consequence of the fashion for Cape plants having gone by. The Tribe is represented by a genus called Mesembryanthemum, consisting of two or three hundred species, and to this my remarks will be confined. The principal part of the genus Fig-Marigold, or Mesembryanthemum, consists of shrubs inhabiting rocks and dry plains in the most arid parts

of the southern extremity of Africa; they have fleshy leaves, often of most singular forms, and partake very much of that power of enduring drought, which, as you have seen, is one of the striking characters of Cactuses. Some of their leaves have a cylindrical form, and are terminated by a short tuft of bristles; in others, the leaves are curved like a Turkish scymitar, or fashioned like an axe; in some they are rounded, so as to look like green pebbles collected into masses; and in several they are bordered by long stiff teeth-like fringes, and curve together so as to resemble the half-open jaw of some savage animal, whence the strange names of Tiger-chap, Dog-chap, Wolf-chap, Mouse-chap, and so on, by which different species are distinguished. Moreover, in one species, not a Cape plant, but an inhabitant of the North of Africa, the whole surface of the leaves and stems is raised into minute transparent blisters, so that the plant has the appearance of one of those beautiful French preserved fruits, which glitter all over with crystals of sugar; this species is known in the gardens by the appropriate name of *Ice-plant* (Mesembryanthemum crystallinum).

With regard to the fructification of this Tribe, it matters little what species we select. Here is one called in the gardens Villet's Fig-Marigold, nearly allied to M. acinaciforme, or the *Scymitar-leaved* (*Plate* XXXI. 2.). It has a succulent calyx of four or five unequal sepals (*fig.* 2.). Its petals are long, narrow, numerous, bright rose-colour, and closely packed one over the other in several rows (*fig.* A. 1.).

The stamens are numerous, and much shorter than the petals; they originate on the outside of a roundish flat, green cushion (*fig.* 4. *a.*), that surrounds the stigma, aud caps the ovary. The latter is inferior, containing about eight cells, divided off from each other by strong dissepiments, but, what is very remarkable, not bearing the ovules at the point where the dissepiments come in contact, but producing them from the centre of the back of each cell (*fig.* 4. *b.*). Hence in this species we have the singular instance of a many-celled ovary, with true complete dissepiments, and common parietal placentation. The stigma is sessile, and divided into as many rays as there are cells in the ovary. I must now warn you, that, although the species before us has this curious arrangement of the interior, yet you will not find the same structure in all species; on the contrary, in some, the back of the cell simply presents a fleshy hump, from the lower edge of which, and the base of the cell, the ovules originate; or, as in most cases, they simply grow from the lower part of the inner edge of the cell.

The latter structure is that of the ripe fruit I send you for examination (*fig.* B. 5.). You will find that it divides at the top into five valves, which close up when the fruit is wet, and open when dry. Each of its cells contains a considerable number of seeds (*fig.* B. 6.), hanging from long stalks, that grow from the lower part of the centre of the fruit. The seeds are angular, and tuberculated (*fig.* 7.), and contain a curved embryo, lying on one side of the albumen.

I have omitted to state, that in this and all the spe-

cies, the flowers close in the shade, or in dull weather, and only expand under bright sunshine. I scarcely know a more interesting sight than in a summer's day, after a storm, to watch a bush of this genus, which has thrown its weak trailing arms over a piece of rock, and which leans forward to the south, as if to catch the earliest influence of the beams it loves so well. While the sky is darkened by clouds, all its blossoms are shut up so closely, that one would hardly suspect the bush of being more than a tuft of leafy branches, with some withered or unexpanded blossoms scattered over them. But the moment that the bright rays of the sun begin to play upon the flowers, the scene changes visibly beneath the eye; the petals slowly part, and unfold their shining surfaces, of almost metallic brilliancy, to the sunbeams, and in a few minutes become so many living stars, often of the most gorgeous tints, and so entirely hide the leaves, that scarcely a trace of them is visible, while the whole bush has burst into a blaze of glittering splendour.

In this case, the phenomenon depends upon a specific irritability of the petals, the cause of which is one of those inscrutable mysteries that the limited faculties of man are incapable of penetrating. But in the fruit there is an interesting phenomenon of another kind, the cause of which is more easily explained. The seed-vessels of the Fig-Marigold, produced, as I have just told you, in the sandy deserts of Southern Africa, fall off when ripe, and are driven about by the wind. If they were to open during the wet season, or in wet places, the seeds would fall out and perish, for it is

only in a dry soil that they are capable of vegetating. Nature, therefore, gives this plant the power, by virtue of its hygrometrical quality, of keeping the seed-vessel fast shut up while exposed to damp, and it is only when it finds itself in a dry station, fit for the dissemination of the seeds, that the valves contract and open sufficiently to allow the latter to escape. It is impossible to imagine a more obvious interposition of Providence than this is, for securing the preservation of the race of Mesembryanthemums.

But it is only one out of hundreds, that might be adduced to show the evident design that is visible in this part of the creation: and, what is not less curious than interesting, where it is necessary for plants to disperse their seeds in the damp, nature provides for this also, with the most admirable certainty, by giving the valves of the seed-vessel the power of opening in humidity; and so employing the same kind of power, that of hygrometrical action, for two opposite purposes. Thus, to use the words of the learned M. De Candolle, the Evening Primroses open the valves of their pods in wet weather, and close them when dry. This circumstance is probably connected with the manner of life of these plants, which naturally flourish in swampy places, and require to sow their seeds when the weather is wet. This notion is confirmed by the history of another plant having the same property, namely, that singular Eastern herb, known under the strange name of *Rose of Jericho* (Anastatica hierochuntica). This grows in the most arid deserts. At the end of its life, and in consequence

of drought, its texture becomes almost woody, its branches curve up into a sort of ball, the valves of its pods are closed, and the plant holds to the soil by nothing but a root without fibres. In this state, the wind, always so powerful on plains of sand, tears up the dry ball, and rolls it upon the desert. If in the course of its violent transmission the ball is thrown upon a pool of water, then humidity is promptly absorbed by the woody tissue, the branches unfold, and the seed-vessels open; the seeds, which, if they had been dropped upon the dry sand, would never have germinated, sow themselves naturally in the moist soil, where they are sure to develope, and the young brood to be nourished. And in this way, a plant, to which the most silly superstition has given celebrity, really presents a truly marvellous phenomenon in its organization. Specimens of this curious production are sometimes brought from Palestine, where it is called Kaf Maryam, and, although they may be many years old, will, if placed in water, start, as it were, from their slumbers, stretch out their arms, straighten their leaves, and assume all the appearance of plants suddenly raised from the dead.

With regard to the affinities of the Fig-Marigold Tribe, it is obvious that generally they are with all the assemblages having both petals and sepals, many stamens, and an inferior ovary; such, for instance, as the Myrtle Tribe, and the Cactus Tribe; but it is especially with the latter that its consanguinity is most near; and it is not a little remarkable, that in the manner in which its fruit is constructed, and the ovules

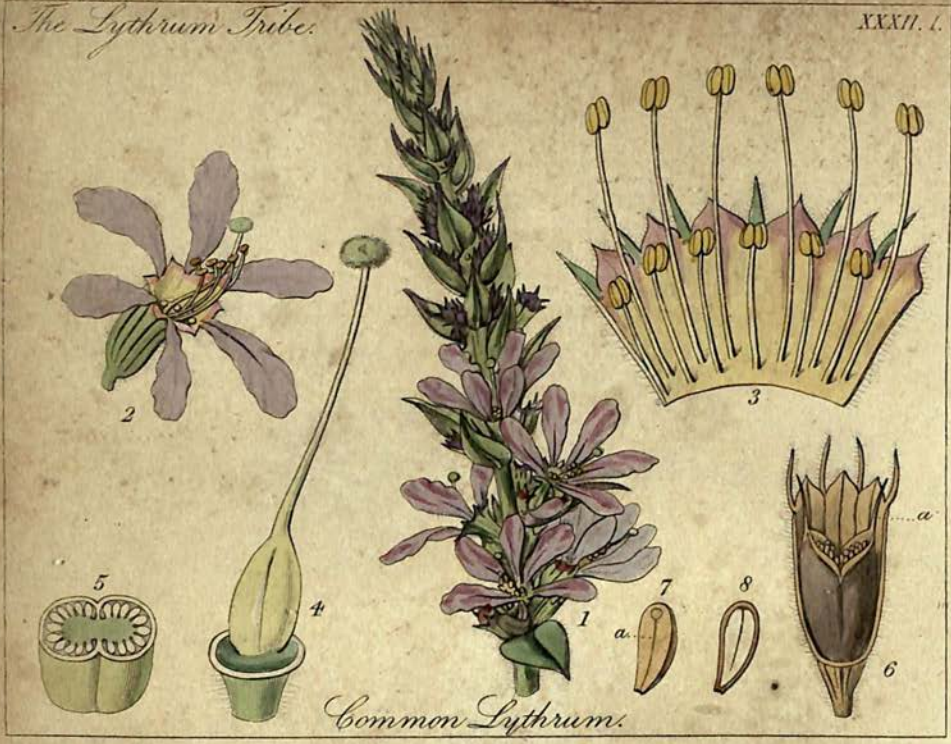
developed, it combines in some cases, in the same species, as we have seen, two different forms of placentation: the central and the parietal.

EXPLANATION OF PLATE XXXI.

I. The Begonia Tribe.—1. The inflorescence of the *stained Begonia* (B. discolor); *a* a fertile flower; *b c* sterile flowers.—2. A side view of an anther, with the cleft through which the pollen escapes. —3. A transverse section of the same.—4. A fertile flower.—5. One of the twisted two-lobed stigmas.—6. A transverse section of an ovary, shewing the three cells, in each of which there is a double placenta covered with ovules.—7. A ripe seed vessel.—8. A seed very much magnified.—9. The embryo.

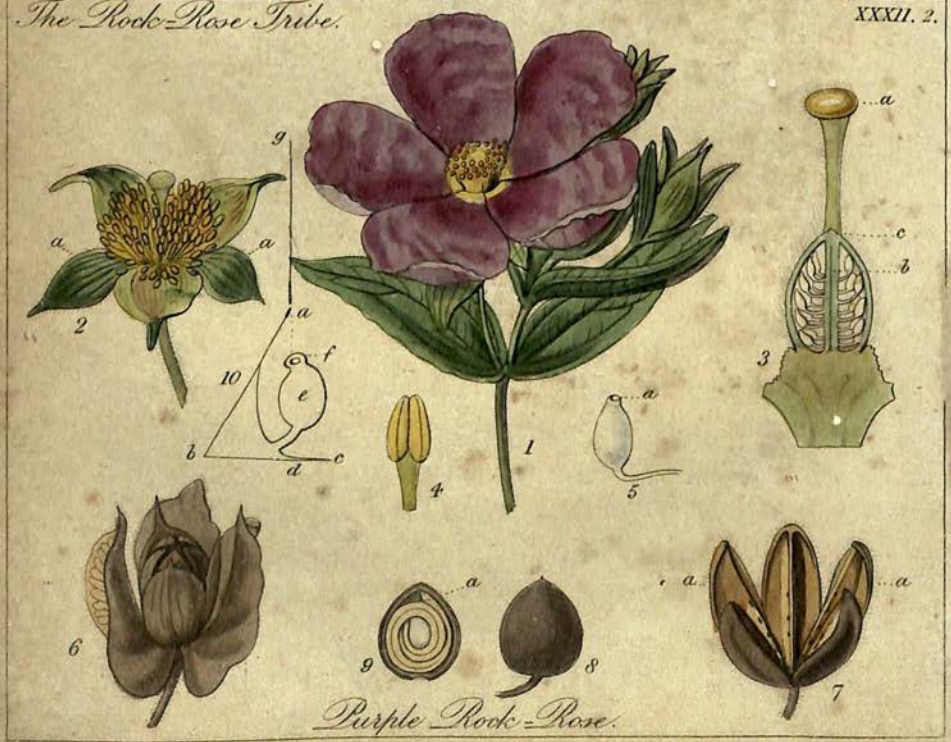
II. The Fig Marigold Tribe.—A. 1. A flower of *Villet's Fig Marigold* (Mesembryanthemum Villeti of the Gardens).—2. Its calyx and stamens.—3. A stamen.—4. A longitudinal section of the ovary; *a*, the insertion of the stamens; *b*, the parietal placentæ; *c*, the stigma.—B. 5. A ripe fruit of Mesembryanthemum, after Gærtner. —6. A longitudinal section of it, shewing the manner in which the seeds are attached to the bottom of the inner angle of the cells.—7. A seed.—8. A section of it with the embryo and albumen.

The Lythrum Tribe. XXXII. 1.



Common Lythrum.

The Rock-Rose Tribe. XXXII. 2.



Purple Rock-Rose.

LETTER XXXII.

THE LYTHRUM TRIBE.—THE ROCK-ROSE TRIBE—MODE IN WHICH THE CONTENTS OF THE POLLEN-GRAINS ARE CONVEYED TO THE OVULE.

Plate XXXII.

In marshes, meadows, by the side of ditches, and, generally, in wet places, there grows a flower which, if it were brought from a distant country, reared in a hothouse, cultivated with difficulty, and sold at a great price, would be the pride of a collector, and the admiration of the crowd that is ever searching for new objects of amusement; for, proudly raising above the neighbouring grasses its long leafy rods, loaded with purple flowers, it stands confessed the undisputed queen of the meadows. But *Lythrum*—for such is its name—is only a wild flower; it may be had any where in autumn for the gathering; it associates with the sedge, and the meadow-grass, and ignoble weeds, and so, it is neglected, except by the few—are they indeed the few?—who love beauty for its own sake, and prize our fair native wild flowers, as much as costly strangers, which are only to be reared by wealth and skill, and which often owe their charms to the adventitious circumstances that surround them.

This plant has a hairy four-cornered stem, about

four feet high, rather closely covered with opposite lance-shaped leaves, which are always more or less hairy, and occasionally, even hoary. As the leaves approach the upper end of the stem, they become smaller, and at length form in their axils two or three flowers, of the following structure. The calyx is tubular, and pale green, with a red border; it has twelve strongly marked streaks, or veins, traversing it in a nearly parallel direction, and it is divided at the edge into twelve little teeth, six of which are short and broad, and six much narrower and longer (*Plate* XXXII. 1. *fig.* 2 & 3.). The petals are six in number, narrow, blunt, crumpled, and light purple (*fig.* 2.). Twelve stamens spring from near the bottom of the calyx, in two rows; one row is shorter than the calyx, the other much longer (*fig.* 3.), and both are curved towards one side of the flower. The ovary (*fig.* 4.) is superior, and has two cells, in each of which are many minute seeds covering a central placenta (*fig.* 5.); the style is slender, and a little longer than the stamens, in the direction of which it is curved; the stigma is a round, velvety little cushion. When the fruit is ripe, it is closely covered by the dried calyx (*fig.* 6.), and is a capsule of two cells opening at the end, and bearing on each valve one half of the style (*fig.* 6. *a*). The seeds (*fig.* 7.) are plano-convex, sharp-pointed at the base, and contain an embryo without albumen (*fig.* 8.).

This structure is remarkable in many respects; in the first place, the striated calyx, and the square stem, both unusual circumstances, are analogous to what we find in the Labiate Tribe, which resembles the Ly-

thrums in little else; then the seeds, the opposite leaves, the stigma, and the habit, are like those of some species of the Evening-Primrose Tribe, which differs, however, in having an inferior ovary, and in several more points; to the Mallow Tribe the Lythrums approach in their tubular calyx, crumpled petals, superior, many-seeded ovary, and double row of sepals; but their distinct stamens growing from the sides of the calyx, not to speak of other differences, prohibit the union of Lythrums with that order.

I will not fatigue you with further inquiries of this nature, but leave you to institute what comparisons you please between Lythrums and such natural groups as you are acquainted with. The result will necessarily be that they are not to be identified with any. Hence, Botanists class them in a distinct set, to which the names of Lythraceæ, Salicarieæ, or the LYTHRUM TRIBE, are given. The great features of the assemblage depend upon the plants being, 1. polypetalous, 2. having a furrowed or striated tubular calyx, 3. having stamens attached to the sides of the calyx, 4 a superior ovary, and, 5. numerous seeds without albumen.

In the gardens we have no common plants belonging to this order, except species of the genus Lythrum; but among the rarer plants are some that deserve mention.

In the first place, the Henna or Alkanna, with which oriental ladies stain their nails and the tips of their fingers a yellowish red colour.

> The Henna that is deeply dyed to make
> The skin relieved appear more fairly fair,

is obtained from a bush belonging to the Lythrum tribe; for this purpose its leaves are pounded, and made into a paste. Botanists call the plant Lawsonia inermis; antiquaries have asserted, without much reason, that it is the Gopher plant of Scripture.

A second object of interest is the beautiful timber used by Cabinet-makers under the name of Rose-wood. By some this production is assigned to a plant called Physocalymna floribunda belonging to the tribe before us; but Prince Maximilian of Wied Neuwied declares that it is yielded by a Mimosa.

While speaking of the remarkable plants of the Lythrum Tribe, the Lagerströmias must on no account be forgotten: Indian and Chinese trees or shrubs, bearing a profusion of large purple flowers, in clusters of considerable size, and one of them (L. indica), at least, nearly hardy in England.

The Rock-Rose Tribe (*Plate* XXXII. 2.) shall be the next object of our examination, and most worthy of it will it prove, whether the beauty of the species belonging to it, or their very extraordinary structure be considered. These plants are well known in gardens, under the names of Cistus or Helianthemum, and are either cultivated as evergreen bushes in the shrubbery, or are employed to ornament rough banks and masses of rock-work, over which they trail or spread with great beauty; they are particularly useful in places so much exposed to the sun as to be too dry in summer for the support of other plants. In such situations they grow with vigour, resist severe

frosts, and all the summer long are every morning adorned with an inconceivable profusion of night-born blossoms, which drink in with avidity the first rays of the sun, but, after a few hours, perish beneath his fervid rays. The colours of these blossoms are yellow, or yellow spotted with deep brown, purple rose-colour, white spotted with purple, or the most pure and dazzling white. The leaves, moreover, of the Cistuses give out a delicious balsamic odour, which, in places where the plants are numerous, literally fills the air, especially after a shower, with a slight, but most agreeable and reviving fragrance. In their native countries, particularly in the south of France, Spain, and the Islands of the Mediterranean, the Cistuses are by far the most lovely objects that Nature has planted in the woods, rocks, and other stations they inhabit.

In their foliage they are not sufficiently uniform for the leaves to form a part of their distinctive character, which in this instance is derived principally from the fructification. The *purple Rock-Rose* (Cistus purpureus) will give you a good example of it.

In that species you have a calyx composed of five pieces (*fig.* 2.), which, however, do not exactly form a single row or whorl; but as you may see by tearing them off, two (*fig.* 2. *a. a.*) grow a very little lower down than the three others, which, moreover, are something larger and a little paler at the edges; such a calyx is said to form a *broken whorl.* The corolla (*fig.* 1.) consists of five equal purple petals, which, from the manner in which they are packed up within the bud,

have a crumpled appearance when the flower unfolds. A great many stamens, much shorter, than the petals, grow in a ring from below the ovary (*fig.* 2.). The ovary itself (*fig.* 3.) is superior, with five cells, in each of which are many ovules, rising upwards upon slender curved stalks, and pointing towards the top of the cell. Each ovule is egg-shaped, and has a perforation, called a *foramen*, at its point (*fig.* 5. *a.*). The style is taper, and rather thicker at the upper than the lower end; the stigma (*fig.* 3.) is a convex undivided space, abruptly terminating the style, and bordered by a delicate fringe of hairs.

When the seed-vessel of this plant is ripe, it is enclosed within the calyx, grown larger, harder, and deep brown (*fig.* 6.). It consists (*fig.* 7.) of five boat-shaped valves (*a. a.*), along the middle of each of which passes a ridge that was, in the ovary, a dissepiment, and to which the numerous seeds adhere. The seeds are little, smooth, stalked, heart-shaped bodies (*fig.* 8.), pointed at the upper end, and containing an embryo, coiled up in the most curiously careful manner (*fig.* 9.); the embryo itself is imbedded in a small quantity of albumen, and, contrary to what usually occurs in other plants, the radicle is placed next the point of the seed (*fig.* 9. *a.*).

Such are not only the characters of the Purple Rock-Rose, but also in a great measure of the whole tribe. The common genera differ from each other, chiefly in little points, that in no way interfere with the more striking features; such for example, as having only three sepals instead of five, having the seed-vessel

very imperfectly divided into cells by short partitions, and so on.

It must be obvious to you, when you come to consider the resemblance of the Rock-Rose Tribe to others, that it has a strongly marked analogy with Poppies (Vol. I. *plate* 1. *p* 19.). They both have crumpled petals, which fall off soon after they expand, a great many stamens growing beneath the ovary, an ovary with parietal placentæ, and numerous seeds. But, on the other hand, they are separated by many equally remarkable differences, as you will see by the following contrast.

Poppy Tribe.	Rock-Rose Tribe.
Parts of flower 3 or 4.	Parts of flower 5.
Calyx in a perfect whorl, and soon falling off.	Calyx in a broken whorl, and remaining on the plant as a protection to the seed-vessel.
Ovules with the foramen next the base.	Ovules with the foramen at the point.
Embryo straight and very minute, in a large quantity of albumen.	Embryo rolled up, filling the inside of the seed, almost to the exclusion of the albumen.
Radicle of the embryo next the base of the seed.	Radicle of the embryo at the point of the seed.

I have just mentioned that the Rock-Rose Tribe has a very extraordinary structure; let me now explain in what that consists. You have already remarked that the ovule (*fig.* 5.) has a perforation or foramen at its point; all ovules have such a perforation, but not all in the same place. In most ovules it is next the base, in a few only does it exist at the point, as in the plants before you. The use of the foramen is not a little curious. You are aware that when the

ovule is first formed it is no more than a mass of pulp, in which little or no organization can be detected internally; but in process of time a small cloudy speck forms in this pulpy interior, and keeps growing larger and larger, till at last it becomes an embryo. It has been observed that the speck always first becomes visible next the foramen; and there is great reason to believe that in reality the speck is introduced into the ovule through the foramen. Further, it is supposed that it is in the anther that this speck is first formed; that it originates in the inside of a grain of pollen; that when the pollen falls upon the stigma, the former puts forth an excessively fine tube, much finer than the most delicate hair; that the tube passes down the style, and continues to lengthen till it reaches the foramen; that the contents of the grain of pollen are discharged into the tube, and the speck with them; that it is then, by some hidden and mysterious agency, carried down the tube; and that, finally, it is thus conveyed into the ovule through the foramen. For all the evidence, and the many curious facts, connected with this part of botany, I must refer you to modern Introductions to the subject; in this place, you must be satisfied with my assurance, that this extraordinary statement is supported, not only by observations of my own, but by the concurrent testimony of all the most cautious and skilful microscopical observers who have engaged in the inquiry.

What I have already stated to you is extraordinary enough, and much cause as you have already found at every step to admire the wonderful care and skill

with which all the actions of vegetable life are conducted, yet I think you must here find a fresh and unexpected source of admiration. You see, that in the formation of the seed of even what we may deem the most worthless weed, there is the same unerring Providence, as in the preservation of the race of man. Only think for a moment, upon the long long journey that the little speck, the tiny rudiment of a seed, has to take before it can arrive at the only place in which it is possible that its destiny can be fulfilled, or that it should be developed into a new being. Born in the pollen-grain, it is originally enclosed in a doubly guarded prison: its own little spherical vault, and the more extensive walls of the anther. The anther must open before the pollen can escape; and it must open too at a particular time, at the very moment when the stigma has secreted a clammy dew, which will hold fast the pollen if it falls upon it. Then the pollen must fall on the stigma; to fall elsewhere is useless. This accomplished, the microscopic rudiment of the seed, which, although not exactly an *être de raison*, for it can be discovered with the microscope, is practically so to human eyes—this almost invisible particle, has to commence a long and winding journey through all the intricacies of the style, and the ovary, till its guardian tube conducts it to the ovule and deposits it in safety. And all this is so provided for, that we find every adjustment exactly that which is best suited to the object in view; invisible springs in the anther, acted upon by the very same cause as that which renders the stigma clammy, combine their million little forces to

pull open the sides of that case; to enable their forces to act with certainty, the sides of the anther are weakened in a particular line, which in every anther of the same species is constantly the same. It is supposed that the clamminess of the stigma is not merely to stick the pollen-grain fast, but also to cause the formation of the pollen-tube; to enable the latter to reach the ovule, notwithstanding its excessive delicacy, the whole texture of the stigma and style is loosened, so as to offer as little resistance as possible to the passage of the pollen-tube. In this Rock-Rose Tribe we have a still further example of the facility with which obstacles to communication between the pollen-tube and the opening in the ovule are overcome.

If we suppose a grain of pollen to fall on the stigma of a Cistus (*fig.* 3. *a.*), its tube may be easily understood to reach the place where the ovules grow (*fig.* 3. *b.*); but when there, it is cut off from the foramen by the whole length of the stalk and sides of the ovule, for the foramen is at the other end of the latter. In order to overcome this difficulty, we are told by M. Adolphe Brongniart, that the pollen-tube does not follow the placenta till it reaches the ovule (at *b.*), but quits the style at the top of the cavity of each cell (*c.*), and thence lengthens in the open space inside the ovary, in the form of the finest imaginable cobweb, till it reaches the foramen in the end of the ovules.

To make this clearer, observe the following diagram (*fig.* 10.). Let the perpendicular *a. g.* represent the style, the line *a. b.* the side of the ovary, the horizontal line *b. c.* the base of the ovary, the curve *a. d.*

the placenta, *e.* the ovule, and *f.* its foramen; then the pollen-tubes may be stated to quit the style at *a.*, to hang down freely in the cavity of the ovary, in the direction of the dotted line *a. f.*, and thus to secure a short line of communication with the foramen.

Many more such cases are to be found by those who search for them; but none much more curious than the present.

EXPLANATION OF PLATE XXXII.

I. The Lythrum Tribe.—1. A twig of Lythrum Salicaria, the *Purple Loosestrife*, in flower.—2. A flower slightly magnified.—3. The calyx cut open, showing the two rows of stamens, and the manner in which they adhere to the calyx.—4. An ovary, with the style and stigma.—5. A horizontal view of the interior of the ovary, showing the ovules adhering to the placentæ.—6. Half a calyx, with the ripe fruit in the inside; *a* one of the halves of the style, carried away on the point of the valve of the fruit when it burst.—7. A ripe seed; *a* the raphe, with the chalaza at its end.—8. A longitudinal section of the seed, showing the dicotyledonous embryo.

II. The Rock-Rose Tribe.—1. A flower and leaves of the *Purple Rock-Rose* (Cistus purpureus).—2. A calyx with the stamens and ovary, *a a* the two outer sepals.—3. A longitudinal section of the ovary; *a* the stigma, *b* the placenta; this gives a good view of the ovules.—4. An anther.—5. An ovule; *a* the foramen.—6. A ripe seed-vessel, invested with the calyx.—7. A seed-vessel burst; the seeds fallen out; *a a* valves.—8. A seed.—9. The same cut longitudinally, showing the embryo rolled up, with the radicle at *a*.—10. A diagram to explain the manner in which the pollen-tubes reach the foramen of the ovule.

LETTER XXXIII.

THE TAMARISK TRIBE—THE SUN-DEW TRIBE—HAIRS OF PLANTS.

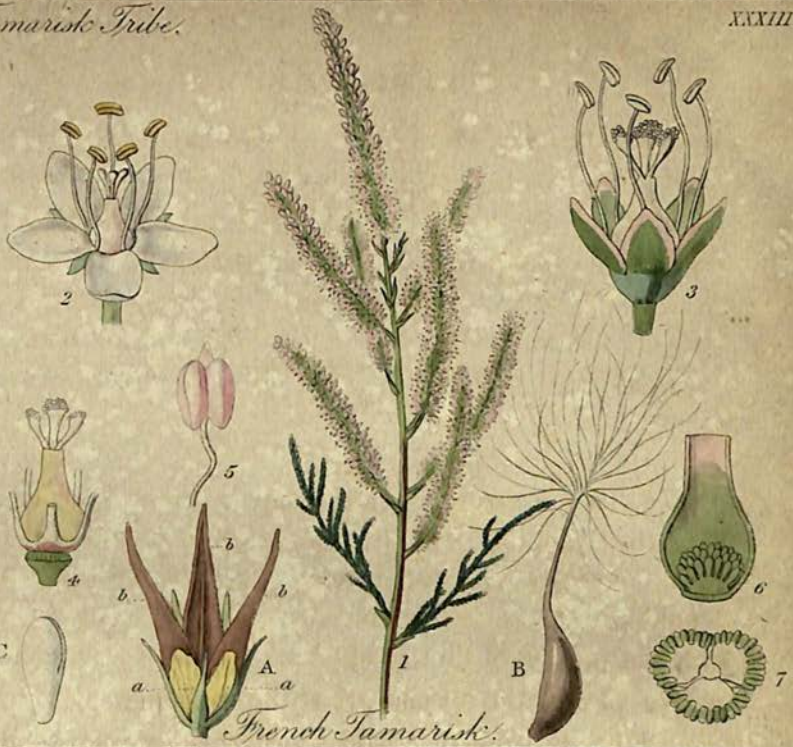
(*Plate XXXIII.*)

We have scarcely a prettier shrub in our gardens than the Tamarisk, with its long, deep-brown, slender rods, delicately studded near the points with green scale-like leaves, or bowing beneath the weight of graceful plumes of faintly blushing blossoms; in their native places the species are still more striking, On the sea-beaten cliffs of a wild shore, the dry rocky bed of a winter torrent, and naked plains of Egypt, the islands of the Nile, the wilderness of Sinai, and the desolate coast of the Red Sea; in these and other such places the Tamarisk rises with its greatest grace and beauty.

There is something in the habit of this plant so peculiar, that the Botanist has always been puzzled to determine with what others it should be allied; and after one incongruous association or another, it seems now settled that it has no very marked affinity with other plants, but really possesses so peculiar a structure as to form a little group by itself.

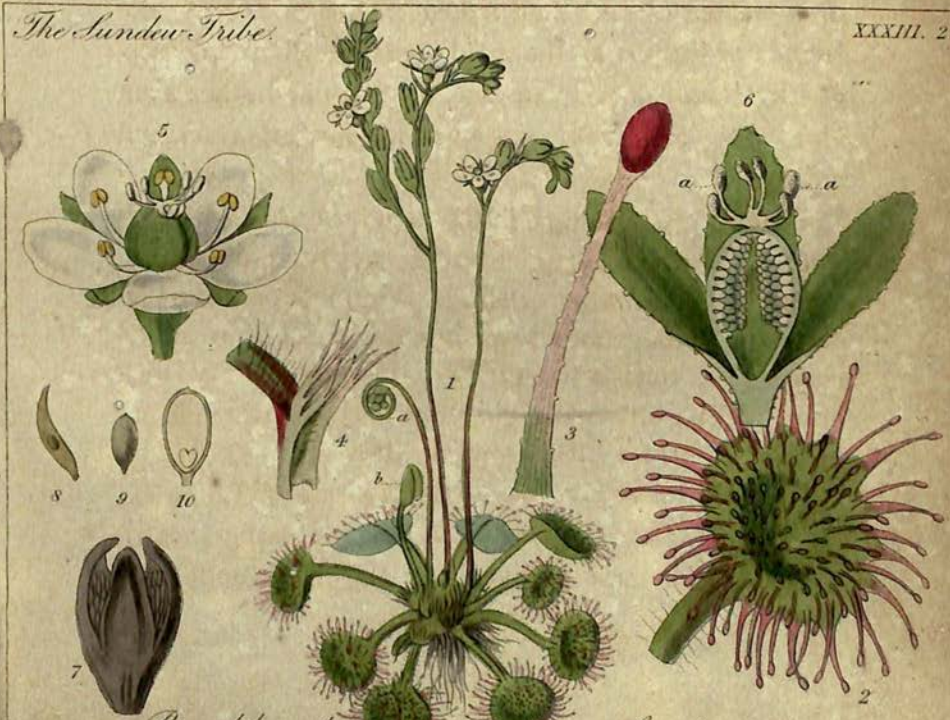
In the gardens are two distinct kinds of Tamarisk, one called the *French*, with dark chocolate-brown branches (Tamarix gallica), and the other called the

The Tamarisk Tribe. XXXIII. 1.



French Tamarisk.

The Sundew Tribe. XXXIII. 2.



Round-leaved Sundew.

German, with a sea-green bark (Myricaria germanica). The former is much the handsomer of the two, and the one we will take for examination.

Its leaves are little green scales, closely packed one above the other, and covering the stem while it is young, but quickly falling off as the branches grow old. The same peculiarity is found in all the plants of the TAMARISK TRIBE. So is the manner in which the flowers are placed, in long, graceful, tail-like racemes, at the extremity of the branches (*Plate* XXXIII. 1. *fig.* 1.).

Each flower consists of a sea-green calyx, having a cup-like downy tube, and five oval lobes delicately bordered with pink (*fig.* 3.); of five spreading white petals (*fig.* 2.); five stamens growing from below the pistil (*fig.* 4.); and a superior ovary. The latter is pale yellow tinged with pink (*fig.* 4.), shaped something like a flask, and suddenly ends in three white styles, each terminated by a thick granulated stigma. The interior of the ovary consists of a single cavity (*fig.* 6.), at the very bottom of which lie three convex placentæ covered with ovules (*fig.* 7.).

I do not find this kind of Tamarisk with ripe seed-vessels, but here is that of the German Tamarisk (*fig. A.*) which does as well. It is divided into three valves, each of which has an elevated ridge along its middle, and is surrounded at the base, not only by the dried up calyx, but also by the petals which adhere to the seed-vessel in the form of little scales (*fig. A. a.*). The seeds in this species are terminated by a long beak, the end of which is surmounted by a

tuft of hairs (*fig. B.*), doubtless intended to enable the seed to ride on the wind, and to be transported from place to place; in the French Tamarisk this provision exists only in a very rudimentary state. In the inside of the seed lies an embryo with two cotyledons, and no albumen (*fig. C.*).

What renders the French Tamarisk still more interesting than its graceful form, is the belief that it was from this plant, or a local variety of it, that the manna fell, on which the Israelites subsisted during their sojourn of forty years in the deserts of Arabia. The celebrated Professor Ehrenberg gathered manna with his own hands from the Tamarisks of the wilderness of Sinai, and it is certain that the species grows plentifully in all the countries adjacent to the Red Sea. That manna did fall from the Tamarisk, is rendered more probable by the fact that this substance is at the present day produced by only two plants in the East, one the Tamarisk, the other the *Camel's Thorn* (Alhagi Maurorum); but as the manna of the Mosaic history is said to have fallen from heaven, that is, from some height, it could scarcely have been produced by the Camel's Thorn, which is only a low bush, while it might easily have dropped from the Tamarisk, which becomes a tree. It is, moreover, not a little curious that the Tamarisk manna is very different in its effects from the bitter sweet manna of the druggists' shops, which is sometimes given to infants as medicine; Tamarisk manna is stated by the chemists, who have examined it, to consist of pure mucilaginous sugar, one of the most nutritious of known substances.

You will presently see that so far as you have any means of judging upon such points, the Tamarisk Tribe has a near resemblance to the Sun-dews or Droseras in some respects, although the resemblances are in reality those of analogy only, and not of affinity.

Queen of the Marsh, imperial Drosora treads
Rush-fringed banks and moss-embroidered beds;
Redundant folds of glossy silk surround
Her slender waist, and trail upon the ground.
As with sweet grace her snowy neck she bows
A zone of diamonds trembles round her brows;
Bright shines the silver halo, as she turns;
And, as she steps, the living lustre burns.

It is thus that Dr. Darwin introduces one of the most curious little plants in the world; and although the exact rules of science will necessarily repudiate such language, yet it must be confessed that there is much poetical truth and beauty in the description.

You will, I am quite sure, be anxious to make acquaintance with Drosera, who would rather seem to be a fairy than a plant, by the poet's description; but I fear there is little chance of your beholding her upon her own moss-embroidered bed, unless by accident: for her home is the fen and the marsh, the oozy heath and the treacherous morass, where she takes possession of every little hillock elevated somewhat above the surrounding waters, and whence no art can induce her permanently to depart. If you snatch her from her native soil, and cherish her with the most curious care, you will hardly succeed in prolonging her existence beyond a

few short months. Let her, however, be sought for by all means, and she will richly reward you for any trouble you may take in procuring her. When she is in your possession, plant her among some bog-moss in a saucer or deep dish, place over her a bell-glass, pour water into the dish till it rises above the rim of the glass, then expose her to the full rays of the sun, and you will have done all that art can effect to secure her.

The structure of Drosera is the following, if you take *the Round-leaved* (Drosera rotundifolia), which is the commonest species, as an example. In this plant the most remarkable part is the leaves, and the least remarkable the fructification. The former are nearly round, and grow upon long hairy stalks; they are at first folded up in such a manner that they look something like little green hoods (*Plate* XXXIII. 2. *fig.* 1. *a.*), but they afterwards spread out into small concave disks, covered over with long, shining, red hairs, that secrete from their point a clear fluid, which gives the leaves the appearance of being covered with dew-drops. Real dew is, you know, always dispersed and dried up by the heat of the sun, so that it is only at the earliest hours of the morning that it can be seen in the summer; but the glittering dew-like secretion with which the leaves of this plant are bespangled is most abundant when the sun is at his highest, and hence it has acquired its popular name of Sun dew; as if the particles of water which cause the leaves to sparkle were really dew, condensed by the sun's rays.

The apparatus by means of which the moisture is

secreted, forms one of the most beautiful of objects for the microscope. Let us take a single hair, and place it under a magnifying glass, taking care to throw upon it from above a strong reflected light, and using the precaution of cutting off all the rays that come from below. You will now see that what seemed a little hair with a drop of water at its point, is really a long curved horn, transparent and glittering like glass; delicately studded from top to bottom with sparkling points; beautifully stained with bright green passing into pink, and mellowing into a pale yellow, as if emeralds, rubies, and topazes had been melted, and just run together without mixing; and finally tipped with a large polished oval carbuncle, or ruby of the deepest die (*fig.* 3.). In this there is no exaggeration; for what tints can possibly represent the brilliancy of vegetable colours, except those of the purest and noblest of precious stones?

If you observe this organ a little more carefully, you will remark a number of faint streaks running side by side from its lower to its upper end, and interrupted at brief but pretty regular intervals, by exceedingly short transverse lines. These marks are external indications of the cells that the organ is composed of; and if you take the trouble to compute the number of such cells required to form it, you will find that there must be at least two thousand such cells in each of these little horns. Everyone of such cells is continually absorbing, and secreting, and digesting the fluids that pass into it from the leaf, or from the air; so that for the due performance of the office of such a minute body as a hair

of the Sun-dew leaf, no fewer than two thousand little digesting cells, or stomachs, are incessantly exercising and combining their tiny forces!

There is still the ruby-coloured point to examine. In its interior structure it is like the hair itself, only all the parts are more solid; it is here that the fluid secreted by the hair is finally concentrated; and it is from this that the dew is continually exuding, so as to stand upon it like a drop of water. The water has a slightly acrid taste, and is probably thrown off from the leaf, because its continued presence in the system of the Sun-dew would be pernicious.

The hairs of our British Droseras possess the power of closing upon insects and holding them fast. "When an insect settles upon them, it is retained by the vicosity of the glands, and in a little while the hairs exhibit a considerable degree of irritability by curving inwards, and thus holding it secure."—(Henslow.) And Dr. Royle describes the phenomenon as occurring so obviously in an Indian species of Sun-dew, that he had called it "the fly-catching" in consequence.

The description just given of the hairs of the Sun-dew, is in part applicable to all other hairs; for they are generally constructed upon a similar plan, and are often, when filled with moisture, most beautiful and elaborately constructed organs. Botanists distinguish two principal sorts of hairs; the *glandular*, in which the hair is either tipped with a secreting organ, as in the Sun-dew, or arises from one, as in the Borage Tribe; and the *lymphatic*, in which there is no secreting organ present, beyond the cell or cells of the hair

itself. For a particular account of them you must turn to works more explanatory of the structure of plants than these letters are intended to be.

Near the base of the leaf-stalk is a long coarse fringe (*fig.* 4.), which is supposed to represent stipules.

The flowers of the Sun-dew, when expanded, are elevated upon a slender scape, along one side of the upper end of which they are arranged; but when young, they are coiled up in a gyrate (or circinate) manner (*fig.* 1. *a*). The calyx consists of five sepals, a little glandular externally, and nearly as long as the petals (*figs.* 5. and 6.). The petals are five, snow-white, flat, blunt, and spreading (*fig.* 5.). There are five stamens, growing from below the ovary, opposite the sepals. The ovary is a superior, oblong case, of one cell, and bears three clusters of ovules on its sides (*fig.* 6.); it is surmounted by three forked stigmas. The fruit (*fig.* 7.) is a capsule, half divided into three valves, and enclosing a multitude of minute seeds. Each seed (*fig.* 8.) is invested in a loose membranous tunic tapering to each end, and contains a kernel (*fig.* 9.) filled with a large quantity of albumen, in the base of which is a minute two-lobed embryo (*fig.* 10).

Many as have been the differences in the combination of the floral organs, in the numerous tribes of plants already examined by you, this is manifestly one to be added to your list; for in no others have you hitherto met with the union of a coiled inflorescence, a few hypogynous stamens, parietal placentæ, and a

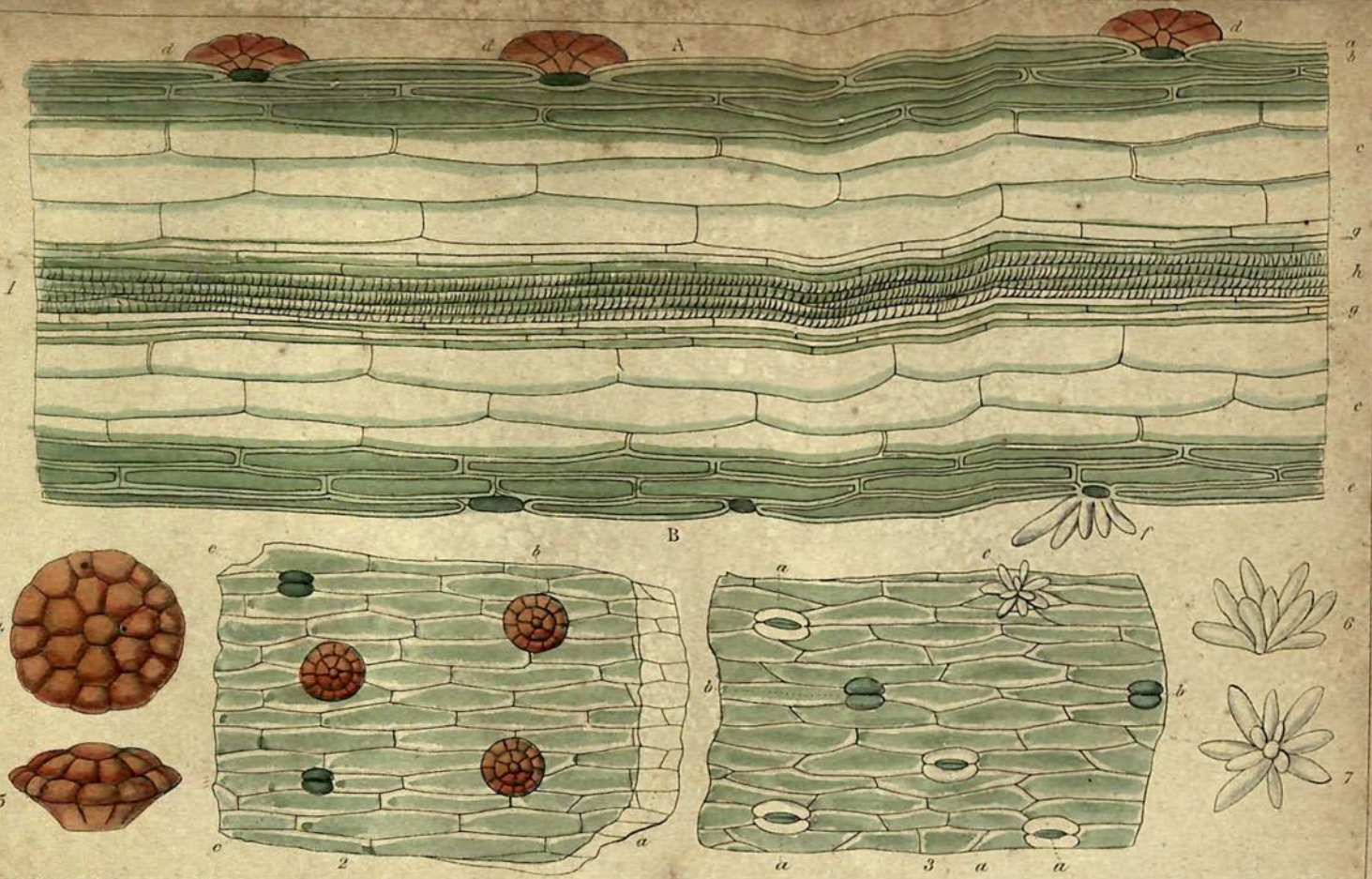
minute embryo lying in the base of the albumen. These characters, independently of all others, distinctly separate the Sun-dews as a peculiar tribe. What the plants really are, to which they are most nearly related, is still an unsettled point. Violets, Saxifrages, Frankenias, have been respectively selected; but there are objections to all those natural groups. It is probable that the true affinity of the Sun-dews is with side-saddle Flowers, most curious plants inhabiting the marshes of North America.

EXPLANATION OF PLATE XXXIII.

I. The Tamarisk Tribe.—1.—A twig of *French Tamarisk* (Tamarix gallica).—2. A flower, magnified.—3. A calyx seen in profile, with the stamens and ovary, the petals being removed.—4. An ovary, with the bases of the five stamens grown into a sort of cup, and surrounding it.—5. An anther, with a portion of the filament. 6. A section of the ovary, showing how the ovules rise from a convexity in the bottom.—7 A section of the convexity (or placenta), shewing that it is not single but triple.—*A.* Ripe fruit of the German Tamarisk (Myricaria Germanica); *a a* the withered petals; *b b b* the valves of the capsule.—*B.* A seed of the same.—*C.* its embryo.

II. The Sun-dew Tribe.—1. A plant of *Round-leaved Sun-dew*; *a* a young scape, rolled up in a circinate manner; *b* a young leaf before expansion.—2. A magnified leaf, showing the glandular hairs.—3. A glandular hair, very highly magnified.—4. The lower end of a leaf-stalk, with the stipulary fringe.—5. A flower, magnified.—6 A section of the ovary, exhibiting the parietal placentation; *a* a stigma.—7. A ripe capsule. 8. A seed, very highly magnified;—9. its kernel.—10. The same divided lengthwise, and exhibiting the embryo at the base of fleshy albumen.

Venus Fly-trap.



Anatomy of the leaf of the Venus' Fly trap.

LETTER XXXIV.

VENUS' FLY-TRAP—ANATOMICAL STRUCTURE OF LEAVES.

(*Plates XXXIV. and XXXV.*)

ARE you acquainted with a most singular plant, the *Venus' Fly-trap* (Dionæa muscipula), an inhabitant of turfy and sandy bogs in the warmer parts of the United States?* If not, search for it immediately in

* I copy the following account of Dionæa, in its American home, from a work on the plants of North Carolina, by Mr. M. A. Curtis, as quoted in the Companion to the Botanical Magazine.

"The Dionæa muscipula is found as far north as Newbern, North Carolina, and from the mouth of Cape Fear River nearly to Fayetteville. Elliott says, on the authority of General Pinckney, that it grows along the lower branches of the Santee, in South Carolina, and I think it is not improbable that it inhabits the Savannahs more or less abundantly from the latter place to Newbern. It is found in great plenty for many miles around Wilmington in every direction.

"I venture a short notice of this interesting and curious plant, not being aware that any popular description of it has been published in this country. The leaf, which is the only remarkable part, springs from the root, spreading upon the ground, at a little elevation above it. It is composed of a petiole, or stem with broad margins, like the leaf of the orange tree, two to four inches long, which, at the ends, suddenly expands into a thick and somewhat rigid leaf, the two sides of which are semicircular, about two-thirds of an inch across, and fringed around their edges with somewhat rigid ciliæ, or long hairs, like eye-lashes. The leaf, indeed, may be very aptly compared to two upper

the nurseries, place it among bog-moss in a greenhouse, and cover it with a bell-glass, keeping it constantly damp. In this manner you may secure for a year or two one of the most curious examples of irritability which the vegetable world contains; and

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eyelids, joined at their bases. Each portion of the leaf is a little concave on the inner side, where are placed three delicate, hair-like organs, in such an order that an insect can hardly traverse it, without interfering with one of them, when the two sides suddenly collapse and enclose their prey, with a force surpassing an insect's attempts to escape. The fringe or hairs of the opposite sides interlace, like the fingers of the two hands clasped together. The sensitiveness resides only in these hair-like processes on the inside, as the leaf may be touched or pressed in any other part, without sensible effects. The little prisoner is not crushed and suddenly destroyed, as is sometimes supposed, for I have often liberated captive flies and spiders, which sped away as fast as fear or joy could hasten them. At other times, I have found them enveloped in a fluid of mucillaginous consistence, which seems to act as a solvent, the insects being more or less consumed by it. This circumstance has suggested the possibility of the insects being made subservient to the nourishment of the plant, through an apparatus of absorbent vessels in the leaves. But as I have not examined sufficiently to pronounce on the universality of this result, it will require further observation and experiment on the spot to ascertain its nature and importance.

"It is not to be supposed, however, that such food is necessary to the existence of the plant, though, like compost, it may increase its growth and vigour. But however obscure and uncertain may be the final purpose of such a singular organization, if it were a problem to construct a plant with reference to entrapping insects, I cannot conceive of a form and organization better adapted to secure that end, than are found in the Dionæa muscipula. I therefore deem it no credulous inference, that its leaves are constructed for that specific object, whether insects subserve the purpose of nourishment to the plant or not. It is no objection to this view, that they are subject to blind accident, and sometimes close upon straws, as well as insects. It would be a curious

which, in some respects, is more striking than even the Sensitive plants themselves, for they merely shrink away from the touch, while this plant firmly grasps, with its wonderful leaves, anything that comes within their reach. Its near connection with the subject of the last letter induces me to dwell upon its peculiarities at some length, independently of its own most interesting organization.

Its leaves spread in a circle round the crown of the root, and either lie flat upon the ground, or gently elevate themselves above the soil. They have no stipules, or stipulary fringes, but consist of two parts, very distinctly separated from each other, and remarkably different in their nature; one of these parts is a stalk and the other a blade, but both so much disguised as hardly to be recognized. The stalk is a flat, green, wavy, obovate, very obtuse, leafy expansion, the veins in which are coarsely netted, with curved branches, which, growing to each other's backs, form a number of somewhat lozenge-shaped meshes (*Plate* XXXIV. 1.). The blade is joined to this by a very narrow neck, and consists of a roundish, thick, leathery plate, slightly notched at each end, having strong hidden parallel veins, which spread, at nearly a right angle,

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vegetable, indeed, that had a faculty of distinguishing bodies, and recoiled at the touch of one, while it quietly submitted to violence from another. Such capricious sensitiveness is not a property of the vegetable kingdom. The spider's net is spread to ensnare flies, yet it catches whatever falls upon it; and the ant-lion is roused from his hiding-place by the fall of a pebble; so much are insects, also, subject to the blindness of accident."

from the midrib to the margin, and bordered with a row of strong, stiff, teeth-like hairs. When young, the two sides of the blade are placed face to face, and the teeth cross each other (*fig.* 1. *a.*); afterwards, when full grown, the sides spread flat, or nearly so, and the teeth then form a firm spreading border (*fig.* 6.). On each half of the blade, stand three delicate almost invisible bristles, uniformly arranged in a triangle. If one of those bristles is touched, the two sides collapse with considerable force, the marginal teeth crossing each other, so as to enclose securely any small object which may have caused the irritation, or pressing firmly upon the finger, when the irritation is produced by it; but wonderful to relate, no other part of the leaf is sensible to external impressions. It is in vain that the back of the leaf is disturbed, or that the smooth glandular surface of the face is irritated; unless you jar one of these bristles no irritability whatever is excited, and the leaf remains immoveably open. The moment the shock is communicated through one of the bristles, the collapse of the leaf is effected, which then assumes altogether the appearance of an iron rabbit-trap when it has closed upon its prey (*fig.* 1. *c.*). If, at this time, an attempt is made to open the leaf, it is violently resisted, in consequence of the rigidity of the side veins, whose contraction seems to be connected with the phenomenon. Upon this subject I shall not dwell any further just now.

The flowers grow in a cyme at the top of a scape, six or seven inches high. They consist of a calyx of five tooth-letted sepals, five very blunt petals, slightly

two-lobed at the point, ten stamens growing from beneath the pistil, and of a superior ovary (*fig* 2.) The anthers are covered over with little glittering glands. The ovary has a depressed form, something like that of an old German wine-bottle (*fig.* 4.); it contains but one cell, in the very bottom of which are two flat placentæ (*fig.* 6.), from which a great number of ovules grow erect; it gradually tapers into a green column of a style, the point of which is split into a ring of fringes (*figs.* 4. & 5.), and forms a stigma. The seed-vessel is a small flask-shaped capsule (*fig.* 8.), closely covered over by the calyx, and remains of the corolla. It contains a considerable number of black, oblong seeds, that are discharged only after the decay of the seed-vessel, which has no means of spontaneously opening. The seeds have a conspicuous raphe (*figs.* 9. & 10. *a.*) and chalaza (*figs.* 9. & 10. *b.*), and contain a kernel enveloped in a soft spongy substance (*fig.* 11. *a.*). The kernel is principally composed of albumen, the embryo (*figs.* 12. *c.* & 13.) being a very small two-lobed body.

Upon comparing this with the structure of the Sundew, it must be obvious to you, that the number of points of identity is extremely numerous, and that, in reality, the most important differences consist in the number of stamens being greater in Dionæa, there being but two placentæ, and those arising from the base of the capsule, the seed-vessel not bursting, the seeds not having a loose integument, the stigma not having twice as many lobes as placentæ, and the leaves being destitute of stipulary fringes upon their stalks.

Such distinctions would be more important, if many more species, corresponding with one another in habit, were found to possess them; but as there is nothing in the habit of Dionæa, materially at variance with that of Sun-dew, and as only one species of the genus has ever been seen, it is not considered absolutely necessary to separate it from the Sun-dew Tribe; especially as the position of the placentæ at the base, instead of the sides of the seed-vessel, is not esteemed of any structural importance. Nevertheless, it is to be remarked, that the flower-cyme is not coiled up, in a circinate manner, before the flowers unfold, that there is no trace of a tendency in Dionæa, to open its seed vessel by valves, and that the loose integument of the seed of Sun-dew has no parallel in Dionæa.

Such are the principal circumstances deserving notice in the fructification of the Venus' Fly-trap. Let us now recur to the highly curious phenomenon from which it derives its name. You have seen that the upper surface of the blade of its leaf is extremely irritable, so that, when it is touched never so gently, the two sides collapse forcibly; it has been said, that this irritability invariably resides in three bristles, similar to the teeth of the margin, but much finer, and growing from the surface of the leaf in a triangular order. Why it is, or by virtue of what power, the bristles possess the key to the irritability of the Dionæa leaf, no one has ever succeeded in discovering. The phenomenon seems to belong to the extensive class of final causes which man is not permitted to explain. We, moreover, find upon the surface, a prodigious multitude of red glands, so

minute as to be individually invisible to the naked eye, but giving a red tinge to the leaf. Such glands are found nowhere except upon the upper surface of the leaf, in the neighbourhood of the delicate seat of irritability. It is in vain that you stimulate the teeth of the margin, the back of the blade, or its stalk; in none of these parts is there a trace of irritability; and in none of these parts is there a trace of the glands. It is not, therefore, improbable that these glands are either in some way connected with the irritability, although it is not they through which the shock is first communicated to the leaf, or, as Mr. Curtis supposes, are intended to absorb the nutriment afforded to the leaf by the decay of the insects entrapped in it.

Let us be a little more particular in the examination of the Dionæa leaf; for it will not only give you instruction in respect to the plant actually before you, but will afford an insight into the general nature of the anatomy of all leaves.

With an exceedingly sharp, thin-bladed knife, obtain a thin slice of a leaf, in the direction of its veins (*as from b to e in Plate* XXXIV. *fig.* 1.), so as to shew its whole thickness. Place it under a good microscope, in water, and by means of the mirror throw light upon the slice from below; it will then become a transparent object, and you will be able to see all that minute, internal organization, which is entirely invisible to the naked eye, and which enables the leaf to breathe, perspire, digest, and perform its other manifold offices. You will also find that a

leaf is not a thin homogeneous mass of firm pulp, nor a confused mixture of pulp and fibre; but a most elaborate, and yet simple apparatus, in which every part is adjusted with the utmost nicety; that, moreover, thin as the leaf appears, it is actually composed of at least nineteen or twenty layers of cells, besides a large line of vessels in its middle. That you may understand this the better, let me refer you to the accompanying sketch of such a slice as I have been talking of (*Plate* XXXV. *fig.* 1.). Let A be the upper surface, and B the lower surface. The upper surface is protected by a very thin, transparent, rather tough, homogeneous membrane (*a.*), which overlies all the cuticle, except perhaps the stomates, and does not appear to be in any degree cellular. It is not improbable that a similar membrane is found on the upper side of all leaves; it has been seen in the Cabbage, the Foxglove, &c. but has not hitherto been much investigated. On the lower surface of Dionæa-leaf, this membrane is absent. Immediately beneath the membrane, comes the skin or cuticle (*b.*), which, although it may be stripped off, nevertheless consists of long, flat, thick-sided cells, adhering very firmly to each other. This you will see more distinctly, if you strip off a piece of the skin from another portion of the leaf, and place it in water, in the same manner (*figs.* 2 & 3.).

From the cuticle of the upper surface there spring, at very short intervals, little red glands (*fig.* 1. *d d d.*), which grow from minute, green, oval spaces, composed of two, parallel, green cells, and resembling stomates.

These are the glands already referred to. They are firm fleshy bodies, resembling little convex buttons; and are composed of cells, arranged in a circular manner, round an axis, consisting of two such cells, stationed one on the top of the other (*figs.* 4. & 5.). I presume that these glands are analogous to the curious hairs of Sun-dew, although we do not see that they are possessed of any irritability; but in the Sun-dew they arise from a general expansion of the cuticle, and not from spurious stomates.

The cuticle of the under side of the leaf is similar to that of the upper; but it is destitute of glands (*fig.* 1. *e.* & *fig.* 3.), in lieu of which little clusters of transparent greenish hairs (*f.*) grow from the abortive stomates. These hairs are each composed of one single cell, and may be considered a rudimentary form of the glands of the upper surface of the leaf (*figs.* 6. & 7.). On the under surface, however, you will find, in addition, a considerable number of true stomates, or breathing pores (*fig.* 3. *a a a.*). What those organs are, and for what purpose they are believed to be intended, has already been explained to you (Vol. I. *p.* 103.).

Immediately beneath the cuticle of either surface of the leaf lies the parenchyma, or pulpy part (*fig.* 1. *c. c.*), composed of several layers of cells, gradually growing larger, more transparent, and thinner-sided, as they approach the middle. The cells of parenchyma are supposed to be the principal seat of digestion and respiration. The food of the plant is propelled into the leaf through the woody tubes

next to be spoken of, from them it is given off to the parenchyma, where it is gradually changed by the complicated processes of digestion, and whence it is returned into the body of the plant. Below the parenchyma run the woody tubes or fibres (*fig.* 1. *g. g.*) which are in this plant short cylinders, but which more generally are very long and flexible; they compose a sheath, 3 or 4 layers thick, to protect the spiral vessels (*h.*): highly elastic tubes, capable of unrolling in a spiral direction, and supposed to be connected with the respiration of plants.

In the accompanying sketch, all the cells of the parenchyma are represented as being in close contact with each other; but, in reality, there are many open spaces among the cells, arranged in no regular order, and believed to be intended for facilitating the passage of air from one part of the interior of a leaf to another.

It is far from being my intention to explain any further, in this place, the anatomical structure of leaves. That of Dionæa gives you a sufficiently just idea of the general plan on which they are formed internally; for more exact information, I must refer you to the higher elementary works on Botany.

EXPLANATION OF PLATES XXXIV. AND XXXV.

PLATE XXXIV.—1. An entire plant of *Venus' Fly-trap* (Dionæa muscipula) in flower, and bearing leaves in different states; *a* represents a leaf before it has expanded; *b* is another fully open; *c* is a third which has closed upon an insect; *d* is a dilated leaf-stalk, on which the blade of the leaf has not formed.—2. A section of a flower with the petals removed; exhibiting the origin of the stamens, the position of the ovules, and the form of the stigma.—3. An Anther, and the upper end of the filament.—4. An ovary.—5. A stigma, closed after fertilization has taken place.—6. A bird's-eye view of the bottom of the inside of the ovary, with the two placentas.—7. A ripe seed-vessel, invested by the withered calyx and corolla; of the natural size.—8. A ripe seed-vessel magnified, with the calyx and corolla stripped off.—9. A seed seen from the side; *a* the raphe, *b* the chalaza.—10. A seed seen from the edge; *a* the raphe, *b* the chalaza. 11. A cross section of a seed; *a* the spongy substance (secundine ?) lying between the testa and the nucleus, *b* the nucleus, *c* the raphe.—12. A kernel taken out of the testa; *a* a portion of the raphe, *b* the albumen, *c* the embryo.—13. An embryo.

PLATE XXXV.—1. A highly magnified view of a slice of the leaf of Dionæa, taken in the direction of the veins; *A* the upper surface, *B* the under; *a* the outer integument; *b* and *e* the cuticle; *c c* the parenchyma; *d d d* the glands; *f* one of the tufts of hairs arising from an abortive stomate; *g g* the woody tubes that surround the spiral vessels; *h* a bundle of spiral vessels.—2. A bird's-eye view of the skin of the upper surface; *a* the outer integument, through which the cuticle is seen; *b* a gland; *c c* abortive stomates.—3. A bird's eye view of the skin of the lower surface; *a a* perfect stomates: *b b* abortive stomates; *c* a tuft of hairs arising from an abortive stomate.—4. Bird's-eye view of a gland very highly magnified.—5. A side view of the same.—6. 7. Views of one of the tufts of hairs that grew upon the under surface.

LETTER XXXV.

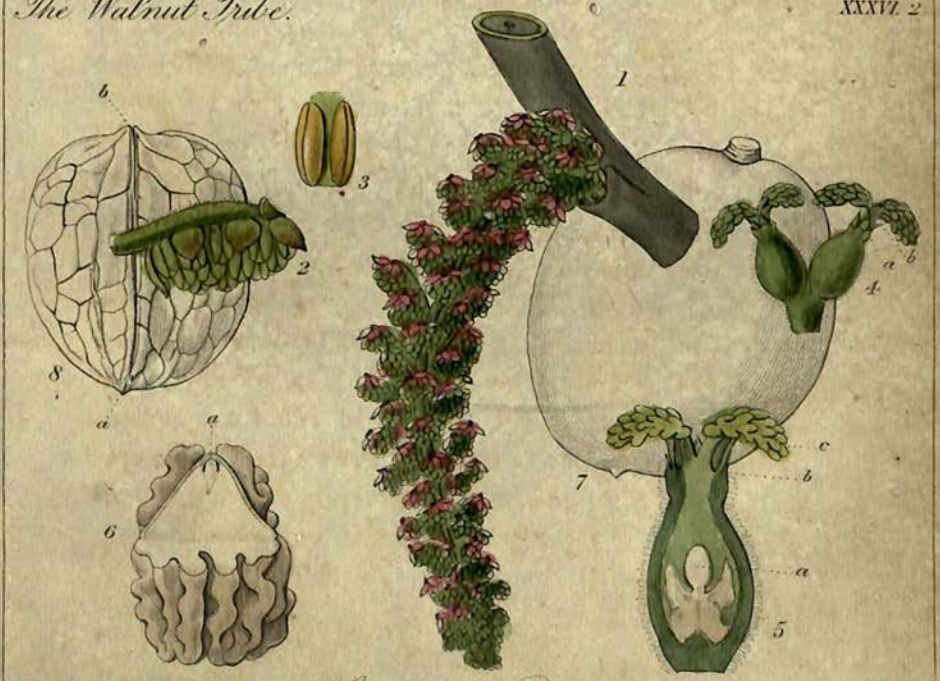
THE HORSE CHESNUT-TRIBE—THE WALNUT TRIBE.

(*Plate XXXVI.*)

You must have often admired the Horse-chesnut tree, either when rising in solitary beauty on the broad greensward of a highly cultivated park, or when, in the form of an avenue, great numbers of those trees combine into high banks of deep green foliage, and gaily tinted flowers. Let us take this plant as our next subject of examination, for which purpose we will select the rose-coloured species (Æsculus rosea, or carnea, *Plate* XXXVI. 1).

Its leaves, you see, are regularly opposite each other on the branches, and are divided into several toothed lobes, which all proceed from one common point at the top of a strong round foot-stalk. The flowers appear in compact, erect, stiff panicles, at the ends of the branches. Their bractes are small, and quickly wither away, falling off, and leaving a scar behind them. Their calyx is a fleshy, smooth, reddish cup, divided at the edge into five unequal, oblong, blunt lobes. The petals are four only; their claw is long and channelled, and inserted below a one-sided, wrinkled, inconspicuous disk (*fig.* 2. *a.*); their limb is oblong, crumpled, crisped, of a bright yellowish red colour, changing

The Rose-coloured Horse-chestnut.



Common Walnut.

into bright orange-yellow at the base, and covered with soft hairs; two of the petals stand at the back of the flower, and two at its sides, overlapping the former a good deal, and exceeding them considerably in size; a fifth petal is wanting from the front, and hence this flower is both unequal and unsymmetrical in its corolla. This irregularity occurs also in every part, except the ovary. We have already seen that the lobes of the calyx are unequal; the disk has also been described as one-sided; and you will next find that the stamens are unsymmetrical, with regard to the surrounding parts. Instead of being five or ten, and so corresponding with the calyx, or four or eight, which would agree with the petals, you will find only seven, which symmetrizes with neither; they are curved downwards towards the front of the flower, their filaments are covered with long hairs (*fig.* 2.), which protect the style, and they terminate in oblong, red, hairy anthers, tipped with a reddish point (*fig* 5.). The pistil is covered with hairs, and bent forwards and downwards in the direction of the stamens. It has a simple style, the point of which, where the stigma is, has no hairs, and a fleshy two or three celled ovary (*fig.* 3.), the sides of which are deeply channelled by the pressure of the filaments. In each cell you will find two ovules, one of which rises up, while the other hangs down, from a projecting horizontal placenta (*fig.* 4.).

The fruit of this plant becomes an unequal-sided, leathery, muricated seed-vessel (*fig.* 6.), opening by two or three valves, and containing one large roundish seed in each cell. The seeds (*fig.* 7.) have a hard,

shining, deep-brown coat, a very broad scar (*fig.* 7. *a.*), on one side, and a little conical elevation, which touches with its point one edge of the scar (*fig.* 7. *b.*). This conical elevation represents the position of the radicle of the embryo that is hidden beneath the seed-coat. Let the latter be removed; you will find below it a roundish, wrinkled, fleshy body, which you cannot separateinto cotyledons, but whose radicle, curved down upon itself, is distinctly visible. Here we have one of several instances, where the cotyledons grow to each other, so as not to be separable. The plumule, or growing point, of this embryo lies closely packed between the bases of the consolidated cotyledons, and one wonders how it is to escape from them, when the time shall arrive for the seed to commence its growth into a plant. A simple alteration in the adjustment of the parts produces the desired effect. As the cotyledons cannot unfold in the usual manner, in order to allow the plumule to pass between them, the passage of the latter upwards into the air is provided for by a slight extension of the bases of the cotyledons, which begin to lengthen when the radicle forces itself into the earth, and thus extricate the plumule from what would otherwise be its prison-house.

The structure that exists in the Red and the Common Horse-chesnuts is nearly the same as what occurs in the other species of the order, which is an extremely small one. The Pavias, or Scarlet Horse-chesnuts, are the only others that deserve notice, and they are so conformable in structure as not to require separate

mention. Indeed, the order itself is chiefly introduced into this correspondence, by way of illustrating points to be hereafter adverted to.

A much more uncommon structure than that of the Horse-chesnut is found in the Walnut, with some account of which, as it is so very common and useful a tree, I may as well fill up the remainder of this letter.

Although my observations will be confined to the common Walnut, they will also apply to the principal part of the WALNUT TRIBE, in which are comprehended all the nuts named by the Americans of the United States, *Hickories*, and from which the Red Indian makes his bows.

The common Walnut is, as you know, a tree of very large size, producing valuable timber, and having, when old, a most majestic appearance; hence Botanists have named it the *Kingly Walnut* (Juglans regia). It bears long pinnated leaves, something like those of the Ash, but placed alternately upon the stem, and having, when bruised, a strong balsamic odour.

The chief peculiarity of the Walnut consists in the fructification, which, while it approaches in some respects that of the Oak Tribe (Vol. I. *p.* 138.), is of an essentially different and very peculiar nature.

The stamen-bearing flowers are on one part of the branch, and the pistil-bearing on another, as in the Oak and its allies. The former (*Plate* XXXVI. 2. *fig.* 1.) are arranged in thick, green, curved, cylindrical

spikes, consisting of very short pedicles (*fig.* 2.) bearing obliquely on one side about twelve stackless broad anthers, surrounded by about six green scales. These spikes fall off soon after the anthers have burst and discharged their pollen.

The pistil-bearing flowers, grow in clusters of two, three, or more (*fig.* 4.), and are composed of an oval, downy ovary, crowned by a minute four-lobed calyx (*fig.* 4. *a.*), four very small petals (*fig.* 4. *b.*), and a pair of fringed stigmas, curved in opposite directions. The interior of the ovary presents a minute cavity, in which is one erect, egg-shaped ovule (*fig.* 5. *a.*), seated on a pale lobed substance, a longitudinal section of which is extremely similar in form to the Russian eagle. The latter substance may be supposed to contribute to the nutrition of the embryo, but its use has not been yet sufficiently inquired into.

In course of time, the stamen-bearing flowers fall off, as has already been stated, the pistil-bearing flowers alter their appearance, lose their stigmas and all trace of a calyx and petals, become much increased in size, and at last change to clusters of oblong, deep-green, fleshy cases (*fig.* 7.), which crack irregularly and drop, leaving behind them the pale brown tesselated nuts, that are sold in the fruiterers' shops (*fig.* 8.). Examine one of these nuts, with which you ought to be well acquainted, because it is of such every day occurrence; and you will find that it might serve as a text for a long and curious disquisition. With only the most striking points however do I propose to occupy your attention.

The nut of the Walnut Tree, deprived of its outer fleshy shell, is of the same nature as the stone of a Peach or Plum; that is to say, it is the innermost layer of the seed-vessel, grown very hard, and separating from the outer layer. At a very early period (as for instance in the state of *fig.* 5.), the two layers formed but one homogeneous body; and when the inside began to harden, without any corresponding change in the outside, still the two held firmly together by a network of veins, the impressions of which give rise to the channels that divide the surface of the nut into numerous irregular compartments.

In one respect the nut of the Walnut differs essentially from the stone of the Peach. In the latter it is not divisible into valves; in the former it readily separates into two equal valves. These are an evidence, although only one ovule is present, yet that this fruit is in reality made up of two carpels, as was indicated by its two recurved stigmas. Now examine the valves separately; each is cut off from the other at the base, by an imperfect partition that rises up from the very bottom; but, above the base, they freely communicate with each other. Their inner surface is marked by numerous elevations and hollows, of a most irregular arrangement, besides which a small plate, originating in the partition at the base, but standing at right angles to it, curves upwards, and cuts each valve imperfectly into two cells; so that, what with the partition at the base, and the plates at right angles with it, the interior of the

nut is, before it is opened, cut into four incomplete cells.

In the centre, where these imperfect plates cross each other, stands the seed, which in growing adapts itself both to the plates themselves, and to the inequalities in the lining of the nut, so that when full grown it is four-lobed, and deeply divided all over by irregular fissures (*fig.* 6.).

The seed, like the ovule, stands erect in the cavity of the nut; but the embryo is inverted, its base or radicle (*fig.* 6. *a.*) being at the point of the seed. The cotyledons are applied face to face, and each participates in the convolutions of the other, until they meet the elevated point of the central plate on which the seed rests; thence they separate in a downward direction, and consequently each pair of shrivelled seed-lobes consists of one cotyledon only.

* In technical language this nut must be described as consisting of two opposite connate carpels, whose margins at the base are turned inwards towards the placenta, whence they are partially produced as far as the back of the cavity of the carpel, forming an adhesion with it, and half dividing the cavity into two spurious cells.

EXPLANATION OF PLATE XXXVI.

I. The Horse-Chesnut Tribe.—1. A panicle of flowers of the *Pink Horse-chesnut* (Æsculus rosea).—2. The stamens and disk (*a*) of one of the flowers.—3. The ovary, with the one-sided disk (*a*) at its base.—4. A longitudinal section of the ovary, shewing the ovules in their two different positions.—5. A stamen.—6. A seed-vessel, natural size.—7. A seed; *a* the scar or hilum; *b* the conical projection on one side of the scar, indicating the position of the radicle.

II. The Walnut Tribe.—1. A portion of a twig of the *Common Walnut* (Juglans regia), with a stamen-bearing catkin.—2. One of the stamen-bearing flowers, in the position in which it hangs in the catkin.—3. A stamen.—4. Two pistil-bearing flowers; *a* the calyx, *b* the petals.—5. A longitudinal section of one of these flowers; *a* the ovule, *b* the calyx, *c* one of the petals.—6. A ripe seed, with a portion of its side cut out to shew the radicle at *a*.—7. A ripe fruit.—8. A nut; *a* the apex; *b* the base.

LETTER XXXVI.

THE HOUSELEEK TRIBE—PURIFICATION OF THE AIR BY PLANTS—THE SAXIFRAGE TRIBE.

Plate XXXVII.

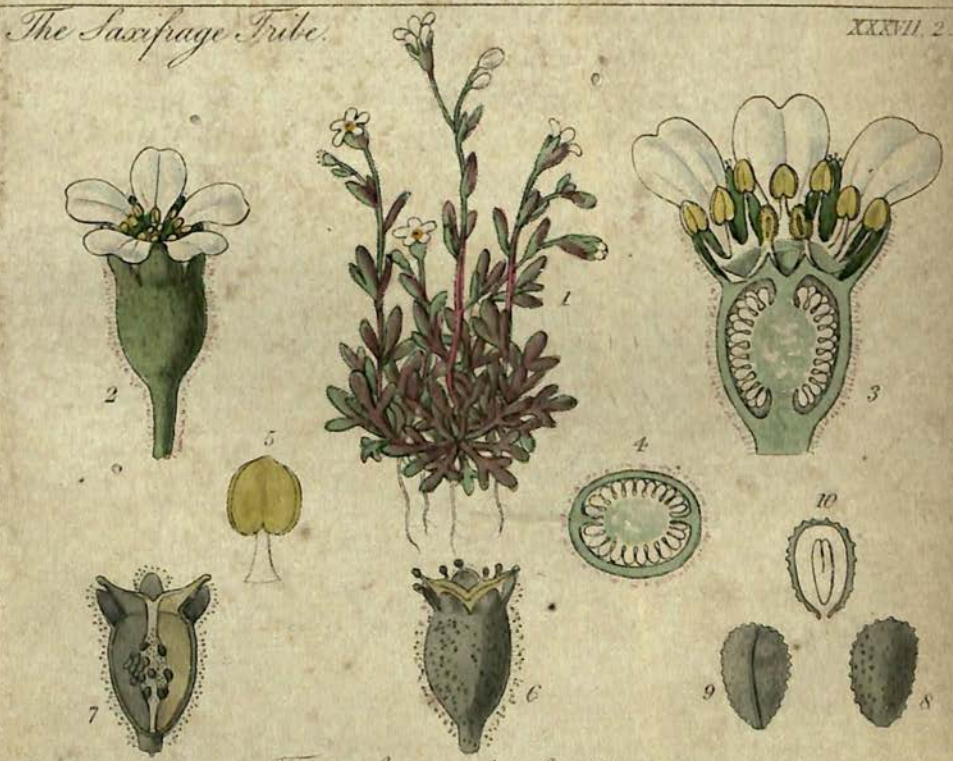
Houseleek (Sempervivum tectorum) is a very common plant upon the roofs of cottages, and on old walls in the country. Its fleshy, starry leaves, are cooling and juicy; and, hence, the peasantry employ them as an application upon burns, or in other cases where the skin is inflamed. It is one of those species which are capable of growing in the most dry and exposed situations, often attracting its food from the atmosphere much more than from the scanty source that its roots have access to. It is usually planted by being enclosed in a lump of moist clay, which is stuck upon the naked tiles of a cottage. In such a situation, the young plant first secures itself by putting forth a few roots into the clay, and then gives birth to a number of little starry clusters of leaves, which surround their parent, and overshadow the place where the roots are to continue to develope: in the first instance, protecting it from the glare of the sun, and afterwards forming, by their decay, a soft vegetable mould, into which other roots may penetrate.

They are enabled to effect this by the power which

The Houseleek Tribe. XXXVII. 1

White Stone-crop. Crassulaceæ

The Saxifrage Tribe. XXXVII. 2.



Three-fingered Saxifrage.

they, in common with all other plants, but in a higher degree, possess of abstracting from the atmosphere its impure air, or carbonic acid, which they convert from a gaseous into a solid state, by separating the charcoal or solidifiable portion, and liberating the vital air or oxygen that was combined with it. By this wondrous process, living plants become the great purifiers of the air we breathe, and it appears quite certain, that if it were not for them the earth would soon become so pestiferous as to be uninhabitable.

All nature is in a continual state of decay and renovation. The perishing remains of animals and plants exhale putrid effluvia, which mix with the atmosphere and render it impure; the incessant action of respiration through the whole animal world, increases the impurity by abstracting the vital air or oxygen, and substituting foul air or carbonic acid. This combined action has been going on from the beginning of the present order of created things, and yet it does not appear that the air we breathe is less suited to our constitutions now than it was in the beginning. This is owing to the agency of plants, which, existing wherever animals or man can exist, are perpetually at hand to catch up and consume the impure particles of the atmosphere as fast as they are generated, and by fixing the carbonaceous part in their own systems, and again liberating the vital air or oxygen, with which the former was in combination, they restore to the air all the purity it had lost.

Here, then, you have another of those admirable proofs of wisdom and design that meet the philosophical

observer at every step. Plants are Nature's eternal laboratories for the decomposition of all that would be injurious to man and other animals—the means by which the nicest equipoise is maintained between two most important opposite principles. Hence it is, that the most tiny blade of grass, or the most obscure weed, becomes in the hand of Providence an efficient means of working out the great design of the creation.

This is not a phenomenon liable to derangement or interruption, but arranged with the most admirable precision in every portion of its details. Thus, for example, although it is through the agency of leaves that the salubrious effect upon the air is brought about; yet we are not to suppose, that when the leaves have dropped from the trees, and the forest exhibits nothing but bare and naked branches, this agency is diminished. Leaves fall off indeed in winter, but at that time the corruption of the air, by the putrefaction of organized matter, is either arrested or very much diminished, and the green carpet which, even in the driest countries, springs up at that season, presents an elaborating surface of immeasurable extent, and amply sufficient to consume such gaseous impurities as may then be endangering. On the other hand, in the spring, when an elevated temperature sets rapidly at liberty the elastic impurities that the winter had bound in chains, leaves, too, are again produced with renewed vigour, and still carry off from the atmosphere all that the rapidly decaying matter is mingling with it, separating for themselves what man is inca-

pable of respiring, and generating in its room in infinite abundance that vital air or oxygen, without which living things would perish.

> Hence, in bright floods, the Vital air expands,
> And with concentric spheres involves the lands;
> Pervades the swarming seas, and heaving earths,
> Where teeming nature breeds her myriad births;
> Fills the fine lungs of all that *breathe* or *bud*,
> Warms the new heart, and dyes the gushing blood;
> With life's first spark inspires the organic frame,
> And, as it wastes, renews the subtile flame.

These very beautiful lines are from the Botanic Garden of Darwin, a writer of an ingenious and philosophical turn of mind, whose poetry is now forgotten, although it has some splendid passages, and contains numerous descriptions of natural phenomena, expressed in language remarkable alike for its magnificence, and for its fidelity to what were, in the author's time, considered facts. Darwin, unfortunately, adjusted his natural phenomena to the unintelligible Rosicrucian machinery of gnomes, sylphs, nymphs, and salamanders, and this, together with the little knowledge that general readers possess of the facts his poetry was intended to illustrate, has been the cause of his poetical writings having fallen into neglect. I would, however, recommend you to read his Botanic Garden, especially the first part, called "The Economy of Vegetation;" you can easily pass by the tiresome Rosicrucian agency, and the remainder you will find extremely well worthy the perusal. But to return from our digression.

The property possessed by the common Houseleek, of growing on dry exposed roofs and walls, is partici-

pated in by a numerous kindred. In Teneriffe, where the genus Sempervivum is very common, the species, which are often shrubs of some size, not only occupy the steep cliffs and rocks in the neighbourhood of the sea, but actually, by their prodigious abundance, conceal the old gothic mansions of the interior of the island, overspreading the walls, and in the flowering season making them glow with the most brilliant golden tints; for the Houseleeks of Teneriffe have yellow flowers, while those of Europe have them of a rosy, purple colour.

Such habits are indeed characteristic of all this tribe. In this country, the various races of Sedums, or Stonecrops, are constantly found in such situations; *Sedum acre* in particular, spreads its scaly stems and shining yellow starry flowers over the tops of walls in some places near London, and the *White Stonecrop* is equally abundant in others. An obscure little moss-like annual, Tillæa muscosa, overruns bleak, stony, naked commons, here and there; and on the grey stone walls of the valleys of the Wye and the Dee, and of the west and south-west of England, the graceful *Navelwort* (Umbilicus pendulinus) rears its delicate bells of green and gold.

Besides these plants, *Rose-Wort* (Rhodiola rosea) puts up its purple heads of flowers in the woods, and by its terrestrial habit establishes the connection between the Houseleek tribe and the commoner forms of vegetation.

No tribe of plants can be more easily known than this; and the *White Stonecrop* (Sedum album, *Plate*

XXXVII. 1.) illustrates its structure perfectly. It has small alternate, succulent, blunt leaves, between linear and oblong. Its flowers are white, and arranged in a compact cyme. The calyx (*fig.* 5.) is an olive-green, fleshy cup, delicately streaked with crimson, and divided into five, blunt, shallow lobes. The petals also are five, white, spreading, narrow, and sharp-pointed (*fig.* 2.). Within these, from below the carpels, grow ten stamens, of which half are opposite the petals, and the other half opposite the lobes of the calyx. At the foot of each carpel (*fig.* 3.) there is a minute, yellow, flat, stalked gland, the end of which seems as if cut off (*fig.* 4.). The carpels have no adhesion to each other, are five in number, and stand opposite the petals, with which they agree in colour, size, and very much even in shape, except that they are rolled up, and taper much more to a point. The fruit is only a slight change from the flower; the calyx and petals have lost their brilliancy, are shrivelled and hang down (*fig.* 7.), the stamens are gone, and the carpels have assumed a pale brown hue; they open at their inner edge (*fig.* 8.), and expose the seeds, which are small, smooth, and oval, and hang from their edges in a single row, upon short curved stalks (*fig.* 9.). The embryo (*fig.* 11.) is white fleshy and taper, and is tightly fitted by the seed-skin, its radicle pointing to the stalk of the seed.

The differences that mark the other British genera of the Stonecrop Tribe are easy enough to remember. *Tillæa* consists of minute moss-like plants, having only three or four petals and stamens, and no scales at the foot of

the carpels. *Navel-wort* has the petals glued together by their edges into a little drooping bell. *Rose-wort* has only four petals and eight stamens. *Houseleek* has from six to twenty sepals and petals, twice as many stamens, and its scales are usually lacerated at the edge.

A consideration of the last mentioned plants necessarily leads to that of the *Saxifrage Tribe*, of which so many species occur in northern and mountainous countries, occupying the tops of walls, the sides, and even summits of mountains, the depths of wooded dingles, the sides of trickling streams, and even the recesses of the wildest bogs. They are remarkable for the exquisite neatnesss of their flowers, which are occasionally yellow or purple, but more generally snowy white, their pureness of colour being sometimes increased rather than destroyed by minute spots of the most clear and delicate crimson.

London Pride (Robertsonia umbrosa), which, although a native of the Yorkshire and Irish mountains, is so patient of smoke and impure air as to have derived its name from that circumstance, is one of the commonest species in cultivation, occurring in cottage gardens as frequently as daisies and primroses. You will know it by its round crenelled leaves, which are collected into little green roses, from the centre of which rises a graceful, reddish, branching panicle, the ends of whose slender branches are tipped by the most delicate little star-like flowers of pink and white. Another species (Leiogyne granulata) is common on banks and in hedges in May, peeping up from among grass and

weeds, with its snow-white flowers drooping at the end of a long stem, scantily clothed with kidney-shaped few-lobed leaves. A third, the *Three-fingered Saxifrage* (Saxifraga tridactylites) springs up from the crest of walls, one of the earliest harbingers of spring. Let us take the latter for examination.

Three-fingered Saxifrage (*Plate* XXXVII. 2.) is a small annual, not much above three inches high, of a dull reddish brown in its foliage, which, as well as the stems and calyxes, is covered all over with glandular hairs of the same colour. Its lower leaves are divided into three tolerably regular lobes, whence its name; but those near the top of the little stems are undivided. The stem is quite unbranched, except near the top, where it divides into two or three forks, each of which is terminated by a single white flower. The calyx (*fig.* 2.) is oblong, and divided at the edge into five ovate lobes. There are five blunt white petals, originating from the side of the calyx; and ten short stamens placed also upon the calyx in a row after the petals (*fig.* 3.). The anthers are roundish flat cases, on short stiff filaments (*fig.* 5.) The pistil consists of a two-celled oblong ovary, which grows to the side of the calyx, almost to its top (*fig.* 3.), and then divides into two distinct, though short, styles, whose stigmas are little oval fringed spaces; you will remark that these styles are not only quite distinct from each other, but do not even spring from the same point, as is most usually the case in other plants. Each cell of the ovary contains a large convex placenta, all over which are placed minute ovules (*fig.* 3 and 4.).

The fruit (*fig.* 6.). is a seed-vessel covered by the glandular calyx, and opening at the point with two spreading valves; to its centre in the inside adhere the seeds (*fig.* 7.), which are exceedingly numerous, oblong, studded with elevated points (*fig.* 8. 9.), and contain an erect dicotyledonous embryo, enclosed in fleshy albumen (*fig.* 10.).

Such is the structure of the Three-fingered Saxifrage, and very nearly such is that of the principal part of its tribe, with the following very remarkable exception. In the plant just examined, the ovary adhered to the calyx for nearly all its length; such a circumstance, if occurring in one genus of a natural group, usually exists in all the remainder. But the Saxifrage tribe offers an exception to this rule; for in Leiogyne the seed-vessel is altogether free from the calyx, and in other cases it is partly free and partly adherent in the same genus.

This occurs in the genus Parnassia, one of the most curious of all wild plants, the companion of Sun-dew in her marshy haunts, and quite her rival in beauty and singularity of structure. The remarkable glands of Drosera are confined to her irritable leaves, and disappear in her flowers. In Parnassia, on the contrary, the leaves and stems are hairless, but there is a most extraordinary glandular apparatus in the flowers. The leaves of this plant are heart-shaped, and cluster round the base of the stem. The latter rises to the height of a few inches, bearing below its middle a solitary stalkless leaf, similar in form to those of the base, and on its point a single nodding white flower, whose petals

are so beautifully marked by diverging sunken veins of a greenish colour, that a fanciful person might liken them to rivulets of chrysoprase flowing over a bed of snow. The glandular apparatus I have spoken of, consists of five fleshy scales, alternating with the stamens, and divided at their edge into numerous rays, each tipped with one beautiful pellucid greenish gland; so that the whole interior of the flower, when inspected from above, seems to bristle with a guard of fairy lances, tipped with sparkling jewels. I know of no natural object more exquisitely beautiful than this little flower, which you may cultivate for a few months by keeping its roots in wet bog-moss, and covering it with a bell-glass fully exposed to the light.

If you consider, as I hope you do, the resemblances of the tribes that are successively brought to your notice, with those which have been previously illustrated, you will have already noticed the near resemblance that exists between the Saxifrage and Rose Tribes. Not, indeed, between the Rose and the little plant we have just been looking at, but between it and the many herbaceous species that belong to the same group with the Rose. One of our usual contrasts will make this quite clear, and we may as well include in the comparison the Houseleek Tribe, which participates in the relationship of the Saxifrages.

I will first contrast their resemblances, and then their differences, in the same table, so that at one view you may perceive why they are placed near each other in the system, and why they are separated.

Saxifrage Tribe.	Houseleek Tribe.	Rose Tribe.
1. Leaves alternate.	1. Leaves alternate.	1. Leaves alternate.
2. Petals distinct.	2. Petals distinct.	2. Petals distinct.
3. Stamens growing from the side of the calyx.	3. Stamens growing from the side of the calyx.	3. Stamens growing from the side of the calyx.
4. Carpels more or less distinct.	4. Carpels more or less distinct.	4. Carpels more or less distinct.
5. Embryo as long as the seed.	5. Embryo as long as the seed.	5. Embryo as long as the seed.
1. Leaves sometimes with stipules.	1. Leaves without stipules.	1. Leaves usually with stipules.
2. Petals sometimes wanting.	2. Petals always present.	2. Petals sometimes wanting.
3. Carpels inferior or superior.	3. Carpels superior.	3. Carpels inferior or superior.
4. Carpels, when ripe, diverging and opening at the point only.	4. Carpels, when ripe, opening along their whole inner edge.	4. Carpels, when ripe, opening along their whole inner or outer edge.
5. Embryo in albumen	5. No albumen.	5. No albumen.

Hence, it appears, that when the differences between these three tribes are strictly inquired into, there is nothing that will positively distinguish the Saxifrages from the Roses, except the albumen of the former, and the peculiar manner in which the two carpels spread away from each other, and open at the point when ripe.

As for the Houseleek Tribe, the distinctions by which it is known are more numerous and obvious, as you will see by studying the table.

EXPLANATION OF PLATE XXXVII.

I. The Houseleek Tribe.—1. A twig of *White Stonecrop* (Sedum album) in flower.—2. A flower magnified.—3. A view of the carpels and the scales at their base, the remainder of the flower being cut away.—4. One of the scales very highly magnified.—5. A calyx-cup.—6. A carpel, more magnified.—7. A ripe fruit, surrounded by the withered remains of the calyx and petals.—8. A view of a portion of the inner edge of a ripe carpel, shewing the manner in which the seeds are attached to its edges.—9. A seed.—10. The same cut across to shew the cotyledons.—11. The embryo.

The Saxifrage Tribe.—1. A tuft of *Three-fingered Saxifrage* (Saxifraga tridactylites).—2. A flower magnified.—3. The same divided longitudinally, shewing the situation of the stamens, and the interior of the ovary with its two styles. 4. A transverse section of the ovary.—5. A stamen.—6. A ripe seed-vessel.—7. The same divided longitudinally, to shew the placenta, to which a few seeds are still seen hanging.—8. 9. Seeds.—10. A seed divided lengthwise, with the embryo lying in the midst of albumen.

LETTER XXXVII.

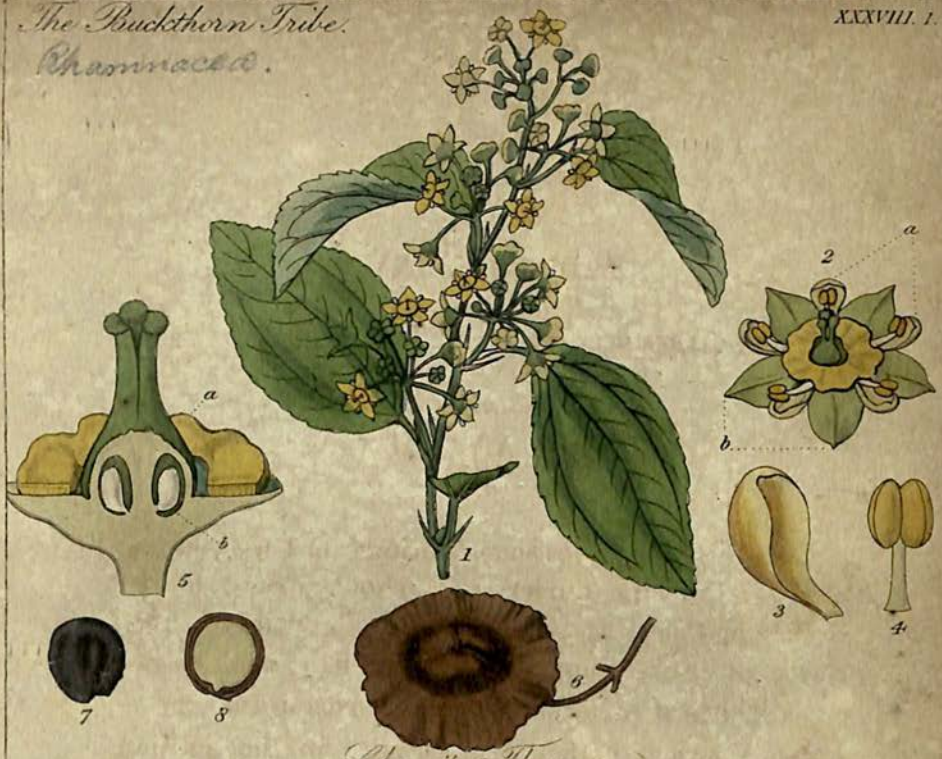
THE BUCK-THORN TRIBE—SPINES—THE SPURGE TRIBE.

Plate XXXVIII.

You will sometimes see in curious gardens, you may always buy in the nurseries, or should you ever visit Greece or Palestine, you will find abundantly in wild rocky places, a spiny shrub, of a light and elegant aspect when it puts forth its new leaves in the spring, but of a savage withered appearance in the autumn, when its leaves are dried and discoloured, and its branches covered with a profusion of little, round, brown, flat seed-vessels, resembling ancient bucklers. This plant is called by the modern Greeks, Paliouri; by Botanists, Paliurus australis, or aculeatus; and by the English, *Christ's Thorn*, because it is said to have furnished the crown of thorns for our Saviour.

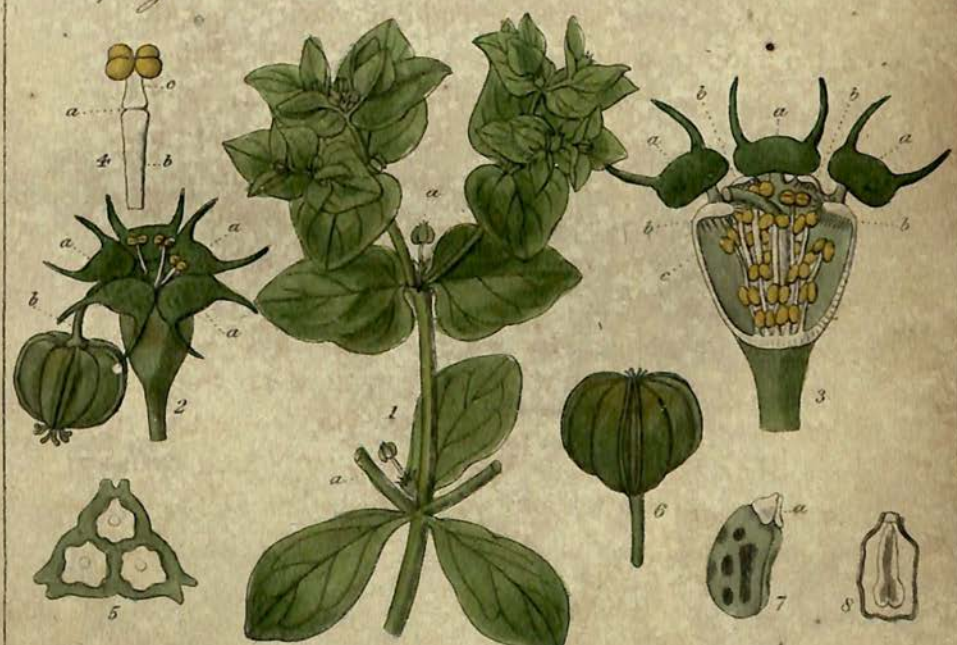
As this is a very interesting plant, we will take it for an illustration of the Buck-Thorn Tribe, rather than the wild hedge-shrub, from which the latter derives its name. Its leaves (*Plate* XXXVIII. 1. *fig.* 1.), are alternately inserted upon slender, flexible branches; they are of an oblong figure, are slightly crenelled at the edge, and have three strong veins, which run from the one end to the other of the leaf, giving it a three-ribbed appearance. The leaves are

The Buckthorn Tribe. Rhamnaceæ. XXXVIII. 1.



Christ's Thorn.

The Spurge Tribe. Euphorbiaceæ. XXXVIII. 2.



Dwarf Spurge.

placed on slender stalks, and in room of the stipules, which are characteristic of the greater part of the Tribe, they have a pair of sharp slender spines, which, upon the old branches, are curved outwards, and become so strong as to render hedges, made from the plant, perfectly impenetrable.

The flowers are pale, greenish yellow, small, and grow in little stalked clusters, which are much shorter than the leaves themselves. They have a flat spreading calyx, divided into five sharp lobes (*fig.* 2. *b. b.*), each of which is a little raised in the middle, and accurately fitted to the edge of its neighbour before the flowers expand; so that, although the edges do not overlap each other at all, they nevertheless form a complete closed cavity, in which the stamens and petals are enclosed. This is one of the marks of the Buck-thorn Tribe, and is called a *valvate æstivation* (See Vol. I. *p.* 168.).

Alternately with the divisions of the calyx are placed five little yellow hoods (*fig.* 2. *a. a.*), which completely cover over the stamens; they are the petals. Opposite the petals are the five stamens; this is the next circumstance that you are particularly to attend to; there are very few instances where the stamens are opposite the petals, and also of the same number, and when it occurs it is always esteemed a structure of importance. After the stamens comes a broad, orange-coloured, lobed, flat disk (*fig.* 5. *a.* & *fig.* 2.), which does not touch the ovary, but simply lies upon the spreading sides of the calyx. The ovary is a little buried in the calyx at the bottom (*fig.* 5. *b.*), but

otherwise is free; it contains three cells, in each of which is one ascending ovule; has a three-lobed style, and a glandular stigma at the end of each of the lobes.

This is all the preparation that is made for the singular fruit, which I have already described as resembling an ancient buckler, but which the French compare to a little head wearing a broad brimmed hat, whence they call it *porte chapeau.* To bring about the metamorphosis from the flower to the fruit, the following changes occur; the calyx—lobes, petals, and stamens drop off, and the branches of the style shrivel up; this reduces the flower to a roundish centre, surrounded by a flat-lobed limb. Then the disk, or limb, grows broader, the ovary swells, both change their appearance, the disk grows the fastest, the whole hardens and becomes brown, and the porte-chapeau (*fig.* 6.) is completed. It contains three cells, externally indicated by three low ridges, and in each cell there is a flat seed (*fig.* 7.). The seed contains an erect embryo, with two thin flat cotyledons, placed face to face, and a very short conical radicle (*fig.* 8.).

In considering the value of the characters thus described, as existing in the Christ's-thorn, you are to abstract—1. the valvate calyx; 2. the five stamens opposite the five hooded petals; 3. the fleshy disk; and 4. the three-celled, half inferior fruit, with one upright seed in each cell; and you will have the characteristic features of the Buck-thorn Tribe. This is the more important for you to understand, because the Tribe comprehends species differing materially, in some respects, from what is found in the Christ's-thorn itself. For in-

stance, few of the genera have a dry seed-vessel, but they more generally bear a succulent fruit; spines also are more frequently absent, or at least are alterations of buds, and not of stipules; and the leaves are most commonly not ribbed; but they all agree in the four characters just selected.

The *Alaternus*, one of those beautiful evergreen shrubs, which give such a peculiar charm to English garden scenery, *Buck-Thorn*, so useful as a cover for game, and the *berry-bearing*, or *black Alder* of our copses, are various species of the genus Rhamnus, which is known from Paliurus by the fruit being succulent, the leaves ribless, and the stipules spineless. It contains several species of some importance for their dyeing properties; sap-green, for instance, is a preparation of the fruit of Buck-thorn (Rhamnus catharticus); the "French berries" of the shops, from which so beautiful a yellow is obtained, are the unripe fruit of the same plant; and yellow morocco leather acquires its colour from the juice of Rhamnus infectorius, and other southern species. The berries of all are unfit for food, and produce extremely unpleasant consequences when taken into the stomach.

Far otherwise is the case with the fruit of the *Jujube* (Zizyphus Jujuba), which, as I fear you know only too well, is mixed with some powerful gluten, and manufactured into lozenges, which are taken in coughs and colds.

Besides these, we have among the ornamental plants of the Jujube Tribe, the superb Ceanothus azureus, whose innumerable clusters of light-blue flowers have

given quite a new character to our gardens in summer and autumn.

The spines of Christ's-thorn, remind me that I have never yet explained to you what spines really are. What they appear to be, I need not tell you; what they are, you may easily learn from a bush of the Sloe, on which they are sufficiently numerous. If you examine them, you will not fail to see that while a part are merely sharp hard points, others have a few buds upon their sides, and many more are invested with leaves, or even flower-cymes. They are, therefore, mere branches, with their points hardened and sharpened. Upon the use of spines, I find the following remarks by the late Professor Burnett:—"In barren, uncultivated tracts of heath, or common land, thorny plants abound, e. g. the Sloe (Prunus spinosa), the Rest-harrow (Ononis spinosa), the Hawthorn (Cratægus oxyacantha), the Buck-thorn (Rhamnus), the Cockspur-thorn (Cratægus crus Galli), and many others. These vegetables, when removed into gardens, and cultivated with care, lose all their thorns, which so thickly beset them when wild, and bear fruitful branches in their stead; becoming, as Linnæus expressed it, tamed plants (Plantæ domitæ), instead of the (Milites or) warriors, to use his language, that they were before. Willdenow was the first who explained the rationale of this metamorphosis, the first who shewed that thorns are abortive buds; but which a deficiency of nourishment prevented becoming developed into branches, and which, when the requisite supply of food is present, speedily evolve their latent

leaves and flowers. But Willdenow did not perceive the beautiful adaption of means to ends, which forms, in my opinion, by far the most interesting part of the phenomenon.

"In open barren tracts of country, the very circumstance of the sterility of the soil must prevent the production of many plants, and of those which grow, few will be enabled to perfect many seeds. It is necessary, therefore, to protect such as are produced from extermination, by the browzing of cattle, otherwise not only would the progeny be cancelled, but also the present generation be cut off. And what more beautiful and simple expedient could have been devised, than ordaining that the very barrenness of the soil, which precludes the abundant generation by seed, should at the very same time, and by the very same means, render the abortive buds (abortive for the production of fruit) a defensive armour to protect the individual plant, and to guard the scantier crop which the half-starved stem can bear?"

These opinions are borrowed from Darwin (*Botanic Garden*, Vol. ii. 139), and are ingenious enough. I am, however, by no means sure that they are well founded. But with objections to them, I am not disposed to entertain you.

Of course you will not confound the spines or thorns of the Buck-thorn, the Christ's-thorn, the White-thorn, the Black-thorn, &c. with the prickles of the Rose, because the latter are also popularly called thorns. True spines or thorns grow from the wood of plants prickles, or false thorns (*aculei*), grow, like hairs, from the surface of the bark.

Another Tribe, related to the foregoing, is that of the SPURGES (*Plate* XXXVIII. 2.); plants distinguished from all others by two characters; the one that of having the stamens in one kind of flower, and the pistil in another, the other that of having a fruit which divides, when ripe, into three coccoons, whence it is called tricoccous. By these peculiarities are combined a large number of exceedingly remarkable plants, many of which are highly deleterious, most of which are exotics, and a very small number of which are either wild in our woods, or cultivated in our gardens.

Among them, few are more remarkable than the *Palma Christi* (Ricinus), with its deeply-lobed, livid, purple leaves, and long clusters of stamen-bearing flowers, at the base of which are clustered a few spiny pistil-liferous ones. Another species is the *Box-Tree*; *Tapioca* and *Cassava* are yielded by a third (Jatropha Manihot); and *Indian rubber*, that curious substance, to whose utility there really seems to be no limit, flows from the wounded bark of others. Arrows are poisoned with the dangerous juice of various species; and there is a long succession of them upon the list of fatal or useful plants.

Few plants are more remarkable for their properties, than *Manchineel* (Hippomane Mancinella).

> "It rests the traveller his weary head,
> Grim Mancinella haunts the mossy bed,
> Brews her black hebenon, and stealing near,
> Pours the curst venom in his tortured ear."

It is a West Indian tree, with which the Indians poison their arrows; and the dew that falls from it is

reputed to be so caustic as to blister the skin, and produce dangerous ulcers; whence many persons have found their death by only sleeping beneath its branches.

This statement is contradicted by some writers, and doubted by others; but there is no sufficient reason for calling it in question. It is perfectly certain that the juice, when applied to the skin, produces a pain like that of red-hot iron, as is proved by the infamous practice of slave-drivers having steeped their scourges in Manchineel juice, before they flogged their negroes.

We have no wild plant that well illustrates the structure of this order, except the common Box. But we have a most common genus, that to a certain degree explains it, and which has a singular structure of its own. This, therefore, which is the common Spurge or Euphorbia, I have selected for illustration.

The common *dwarf Spurge* (Euphorbia Peplus, *Plate* XXXVIII. 2.) is an annual, with a slender, smooth, branching stem, which discharges in profusion a milky juice when wounded. It is a general property of its tribe to do the same. Its leaves are obovate, tapering to the base, stalkless, and placed in a ring of three, immediately below the branches that bear the flowers. The leaves of the flower-branches are differently shaped from those of the stem, opposite in pairs, ovate with a heart-shaped base, and sharp-pointed.

The flowers either grow in the forks of the branches (*fig.* 1. *a. a.*), or among the uppermost leaves singly. They are green cups (*fig.* 2.), of a most curious con-

formation. The edge of the cup is divided into ten lobes, of which five are flat, spreading, glandular, and two-horned (*fig.* 2. *a. a.* and *fig.* 3. *a. a.*), and five scale-like, inflected, and fringed with hairs (*fig.* 3. *b. b.*). From the very bottom of the cup rises a cluster of stamens, of unequal lengths, each having a joint in the middle (*fig.* 4. *a.*); these stamens rise up one by one, or in very small numbers, protrude themselves beyond the mouth of the cup, to discharge their pollen, and, then shrivel up. From their centre springs a long, green stalk (*fig.* 2. *b.* and *fig.* 3. *c.*), curved downwards by the weight of a roundish ovary that grows upon its summit. There is a joint in the stalk of the ovary of the same nature as that in the stamens.

The ovary (*figs.* 6. & 5.), is three-cornered, has a double short wing at each angle, and contains one pendulous ovule in each cell; two stigmas, or rather a two-lobed stigma, rises from each lobe of the ovary. The seed-vessel is of the same form as the ovary, and separates with elasticity, when ripe, into three cases, or cocci, out of each of which falls a single seed. The seeds are slightly downy, pale straw-coloured, faintly spotted with purple, and unequally six-sided (*fig.* 5.); next the hilum, they have a white fleshy protuberance, called a *caruncula*, and they contain an embryo with two short cotyledons, and a long slender radicle lying in fleshy albumen.

What now is the real nature of the parts we have been examining? It used to be thought that the green cup was a calyx, and that the stamens were of the same nature, exactly, as other stamens. But it was

remarked, in course of time, when more exact views of Botany began to be entertained, that a joint in the apparent filament was seen nowhere else, that another in the stalk of the ovary was equally unusual; that from this joint there sometimes springs a sort of cup-like membrane; that the confused arrangement of the stamens was extremely unlike the regularity with which those parts are usually inserted; and, finally, that no other genus could be found in the tribe of Spurges, in which the stamens and the pistil occur in the same flower. These considerations led to the discovery that the cup is an involucre, with a glandular and lobed border, that each stamen is a single flower, consisting of a single stamen, without either calyx or corolla, the place of those organs being indicated by the joint in their middle, and that the ovary in the centre is, in like manner, a single, separate flower; so that the apparent flower of a Spurge is in reality a curious kind of flower-head.

Thus you see, that even in so humble and insignificant a weed as this, there is much to study and admire. In general the species of Euphorbia are possessed of but little beauty, but there are some remarkable exceptions; for their floral leaves, and their cups, or the glands upon them, become in certain cases coloured of the most vivid tints, scarlet, crimson, emerald-green, or white, and as the parts are usually enlarged in proportion, a most brilliant effect is occasionally produced, notwithstanding the universal want of calyx and corolla in this tribe.

EXPLANATION OF PLATE XXXVIII.

I. The Buck-thorn Tribe.—1. A twig of *Christ's-thorn* (Paliurus australis).—2. A flower magnified; *a a* petals, *b b* lobes of the calyx.—3. A petal separate.—4. A stamen.—5. A section of the ovary and disk; *a* the disk, *b* the part where the ovary grows to the side of the calyx.—6. A ripe fruit, natural size.—7. A seed.—8. A section of the same, exhibiting the flat embryo.

II. The Spurge Tribe.—1. The upper part of the stem of *Dwarf Spurge* (Euphorbia Peplus), with the common leaves at the bottom and the floral leaves occupying the remainder of the specimen; *a a* flower-heads.—2. A flower-head, magnified; *a a* glandular divisions of the involucre; *b* the pistil-bearing floret in the centre.—3. A section of the involucre; *a a* the glandular lobes; *b b* the inflected lobes; *c* the stalk of the pistil-bearing central floret, surrounded by the naked stamen-bearing florets.—4. A stamen-bearing floret; *a* the joint between *b* the pedicel, and *c* the filament.—5. A section across a nearly ripe fruit, shewing the short wings at the angles, and the seeds with the embryo lying in the centre of the albumen of each.—6. The same ovary, uncut.—7. A seed; *a* its caruncula.—8. A longitudinal section of the same, with the embryo surrounded by albumen.

The Flax Tribe. XXXIX. 1.

Perennial Flax.

The Rue Tribe. XXXIX. 2.

Garden Rue.

LETTER XXXVIII.

THE FLAX TRIBE—ABORTIONS—LINEN

THE RUE TRIBE.

(*Plate XXXIX.*)

AMONG the plants that are grown in fields, for their utility, the prettiest, I think, is Flax, with its nodding blossoms, and its light-blue petals, which, day after day, during the flowering season, continue to strew the soil with azure fragments. It was once considered a member of the Chickweed Tribe, but if you compare it with the species of that group, you will wonder, not that it is now separated, but that it should ever have been associated with them.

In the first place, its stems and leaves are quite different; the joints of the former are not swollen, and the latter are not opposite (*Plate* XXXIX. 1. *fig.* 1.). Secondly, its calyx has the sepals in a broken whorl (*fig.* 2.), two external, and three internal, which is not at all the character of the Chickweeds; moreover, the ovary contains ten cells, in each of which is one pendulous ovule (*fig.* 5.); and finally the seed vessel splits into ten sharp pointed valves (*fig.* 6.). These circumstances are considered sufficient to elevate the Flax into the type of a natural assemblage, consisting of scarcely any other genus; and accordingly the Flax

Tribe is now admitted into the works of all systematic writers.

Its principal points of agreement with the Chickweed Tribe consist in its having five petals, five stamens growing below the ovary (*fig.* 3.), and five distinct styles; all points of slender importance in themselves, and in the present instance quite neutralized by the nature of the predominating differences above explained.

It might have been more correctly allied to the Mallow Tribe, for you will remark that its stamens grow into a tube (*fig.* 3.), that it has pin-headed, or, as we say, capitate, stigmas, and several one-celled carpels, arranged in one whorl round an imaginary axis; it moreover agrees with that group in possessing mucilaginous properties. But on the other hand, its leaves have no stipules, its calyx is extremely different from the valvate one of Mallows, and it has not their crumpled folded embryo.

In fine, it is rather to the Rock Rose Tribe, and the plants assembled in that vicinity, that Flax must be compared, as you will hereafter see.

Among the peculiarities of Flax, that do not belong to its character as a distinct natural group, but that are exclusive to the genus Linum, of which it is a species, are two that deserve particular notice; the one, the abortion of half its stamens, the other, the occurrence of a ten-celled ovary, in connection with five styles.

You will remark that the five stamens of Flax are united by their base into a downy cup (*fig.* 3.), and that five small teeth (*fig.* 3. *a. a.*) alternate with them.

The teeth are the rudiments of stamens, and show that there is a tendency in Flax to produce ten stamens, but that, owing to some unknown, constant cause, only five of them are actually developed. This disposition to form parts, without actually forming them, is what Botanists call *abortion;* and is one of the most common of all phenomena. The knowledge of the fact is of great importance, because it helps us to reconcile apparently contradictory circumstances, and to reduce, within fixed rules, the laws that regulate the innumerable modifications and combinations of the organs of plants. One or two examples will make this clearer to you.

It is an established axiom that the divisions or parts of each successive whorl of organs, are placed alternately with those which succeed them. Thus the following arrangement of letters will show the successive positions of the parts of a flower that consists of five sepals (S), five petals (P), five stamens (s), and five carpels (c.); provided the parts were placed in parallel rows instead of concentrically—

S S S S S
P P P P P
s s s s s
c c c c c

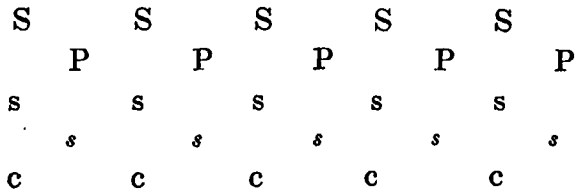
so that the stamens would be opposite the sepals, and the carpels opposite the petals.

But if the number of petals were ten instead of five, the position of the stamens, with respect to the sepals, would be altered, and the latter would be opposite the first or outer row of petals, thus—

S S S S S
P P P P P
P P P P P
s s s s s
c c c c c

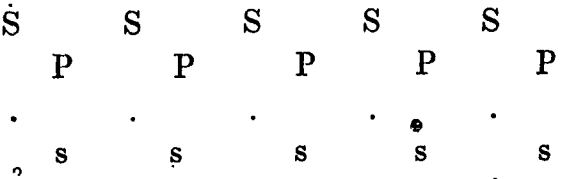
And other changes in proportional numbers would be productive of corresponding alterations of position. These differences are found of great importance in systematic Botany, and every good writer pays the most careful attention to them. Their value is very much increased by considering the nature and degree in which abortion takes place, and observing, by the manner in which it affects the usual order of succession, whether it indicates a tendency to the production of more rows of parts than actually develope, or to the suppression of a portion of those rows that are in part completed, and what relation is really borne to each other by the parts that appear, and those that do not develope. If you look into this subject practically, you will find that the abortion of particular organs, or rows of organs, is, in a great number of cases, the most unerring sign by which certain natural groups are distinguished, and that the importance of the abortions, in a systematic view, is in proportion to the degree in which they derange the symmetry of the flower, or cause a deviation from regular structure. I cannot do better than give you several instances of this, by tables similar to the preceding, in which the letters have the same value as before; those which indicate partial abortions being printed in italics, and in a smaller type, and total abortions being represented by dots.

Let us begin with Flax itself, which offers but a slight instance of abortion. Its parts are thus—

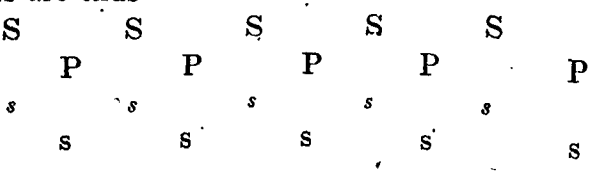


Here the consequence of this presence of the abortive row *s*, is to throw the carpels out of their place, and to bring them opposite the sepals, instead of opposite the petals.

The Primrose Tribe shows a deviation of a more important nature. Its calyx, corolla, and stamens are thus—



In this case the third row, whether belonging to the petals or stamens is missing, and the consequence is that although the stamens are equal in number to the petals they are opposite to them, instead of alternate. This also happens in the Buckthorn Tribe, and elsewhere, but I have chosen the Primroses to illustrate this sort of irregularity, because that tribe, in the instance of the genus Samolus, contains a proof that the abortion which theory points out really does exist. Its parts are thus—



These cases, however, are nothing to what occurs from abortion in many Endogens. The greater part of the Orchis Tribe is thus—

S S S
P P P
. s .

The Arrow-Root Tribe thus—

S S S
P P P
P P .
. . s

The Ginger Tribe thus—

S S S
P P P
. . P
s s s

The Banana Tribe thus—

S S S
P P P
s s s
s s or . s

which is very nearly in accordance with the ordinary structure of Monocotyledonous groups.

Perhaps, however, there is no more curious case of extensive alteration in structure, in consequence of abortion, than in the Mint Tribe, of whose flowers the following letters express at once the theoretical and real composition—

S S S S S
P P P P P P
or or
P P
s s . s s
or or
. .
c c

In the Mint Tribe it is especially to be remarked that each carpel is divided into two lobes, so that, although there are four external partitions in the ovary, yet there are only two carpels, which, in fact, correspond with the two lobes of the style. That three other carpels are undeveloped, is proved by certain cases in which they are actually present, in addition to the two ordinary ones; in such instances the ovary consists of ten lobes, and the style is divided into five little segments.

This fact brings me back to the second subject, which, I have already said, deserves particular notice in the Flax; namely, the ten cells of the ovary, and the five styles. I need scarcely now repeat, that, under all circumstances, the number of styles corresponds with the number of carpels of which the pistil is composed, or of the lobes of the stigma when the styles are all consolidated, provided any lobes are discoverable. As in the Mint Tribe, under ordinary circumstances, there are four lobes of the ovary, and two lobes of the stigma, it therefore follows, that each carpel is two-lobed; and I have just explained that certain monstrous cases prove that such is really the fact. Now suppose that two such lobes are consolidated, we then have carpels each with two cells, as in the Vervain Tribe, and this is only what we find in the Flax. You will observe, however, that although in the latter plant there are two cells to each carpel, yet the dissepiment that divides them is imperfect (*fig.* 5. *a a*); so that, although, for the purpose of illustration, I have supposed that each carpel of the Flax may be formed by the consolidation of two lobes, yet it is

more probable that in reality its peculiarity is simple owing to the projection of a short plate from the back into the cavity of each cell.

Common Flax (Linum usitatissimum), as its name imports, is the plant from which *linen* is manufactured. Its stems are soaked for a long while in water, until the cellular substance rots away, and then the tough fibres that remain behind are cleaned, dressed, and converted into linen thread. You are doubtless aware of the great superiority of linen over cotton thread, in regard to durability and toughness. This is owing to the different nature of the organized substance from which they are prepared. The part of the Flax that remains after maceration is its woody tubes, the toughest and strongest part of the vegetable fabric, and that to which all plants owe their flexibility and strength. It is the part which enables the leaf to bear the violence of the storm without injury, which gives its value to timber, and which enables the cane and the lancewood to bend so freely without breaking. Cotton, on the contrary, is merely the hair that grows upon the seed of the Cotton plant, and is a form of that cellular substance which constitutes the parenchyma of leaves, the delicacy of flowers, and the pulpiness of fruit, which fills up the interstices between the woody tubes, and holds together the sinewy framework of vegetation.

Garden Rue (Ruta graveolens, *Plate* XXXIX. 2.) is the type of a very extensive natural group, called, after it, the Rue Tribe. It consists of plants having

a powerful, and usually a nauseous odour, and their leaves filled with transparent dots (*fig.* 7.), in consequence of their secreting an essential oil, which renders them valuable in cases of spasms.

Rue itself, *Fraxinella*, covered with fragrant glands, which are said to exhale the volatile parts in such abundance in hot weather as to render the atmosphere that surrounds it inflammable, and different sorts of *Diosma* and *Correa* are those which are most common in gardens. The remainder are principally exotics, which are little known in cultivation. Rue itself will give you a good idea of their general nature.

It is a perennial, hairless, glaucous plant, having a strong, peculiar, disagreeable odour. Its leaves are unequally pinnated, rather fleshy, crenelled, and dotted like those of an Orange. The flowers are greenish-yellow, and grow in cymes at the end of the branches. The calyx (*Plate* XXXIX. 2. *fig.* 2.) consists of four spreading, toothletted sepals. There are four petals, with short claws, and a very concave toothletted end. Eight spreading stamens arise from a fleshy ring surrounding the ovary, and having about sixteen pits impressed upon it, in a circle, a little above the origin of the stamens (*fig.* 2.). Upon this ring is planted a conical, four-lobed uneven ovary, consisting of four cells, which are not parallel, as usually is the case, but spread away from each other at the base, around a fleshy elevated centre (*fig.* 3. *a.*). Altogether the mass of fleshy matter, upon which the cells of the ovary are placed, is so considerable as to have in systematic Botany a particular name, that of *gynobase*.

The cells of the ovary contain about four ovules, placed upon a prominent placenta (*fig.* 3. *b.*). The style rises from between the points of the lobes of the ovary, and is divided at its apex into four obscure teeth. The seed-vessel is a light brown dry capsule, splitting into four cocoons (*fig.* 4. *a.*), in each of which is a single seed, and which surround the thickened hardened gynobase (*fig.* 4. *b.*). The seeds are dark brown, pitted, angular bodies (*fig.* 5.), containing an embryo lying in the midst of fleshy albumen (*fig.* 6.).

Such is the structure of Garden Rue, and the same is found more or less in the numerous genera referred to its tribe. As you are little likely to meet with many of them, I will only remark that some are curious, as Correa, for having their petals united into a tube, like that of a Monopetalous plant, and that they do not differ much from the Orange Tribe, (Vol. I. *p.* 86. *Plate* VI. 2.), except in their dry splitting fruit, their great fleshy gynobase, and their albuminous seeds.

EXPLANATION OF PLATE XXXIX.

I. The Flax Tribe.—1. A twig of *perennial Flax* (Linum perenne).—2. A magnified flower, from which the petals have dropped off.—3. The stamens and styles; *a a* teeth representing abortive stamens.—4. The ovary with the bases of the five styles.—5. A section of the ovary; *a a* the imperfect dissepiments.—6. A ripe seed-vessel, with its valves separated.—7. A seed.—8. A section of the same, shewing the embryo.

II. The Rue Tribe.—1. *Garden Rue* (Ruta graveolens).—2. A magnified flower, without the petals; *a* the ring of pits above the stamens.—3. A section of the ovary; *a* the gynobase, *b* the placentæ.—4. A seed-vessel, from which the seeds have fallen; *a* the cocoons, *b* the gynobase.—5. A ripe seed.—6. The same cut longitudinally to shew the embryo and albumen; *a* the hilum.—7. The tip of a leaf, with its pellucid dots.

LETTER XXXIX.

THE BUCKWHEAT TRIBE—THE GOOSEFOOT TRIBE.

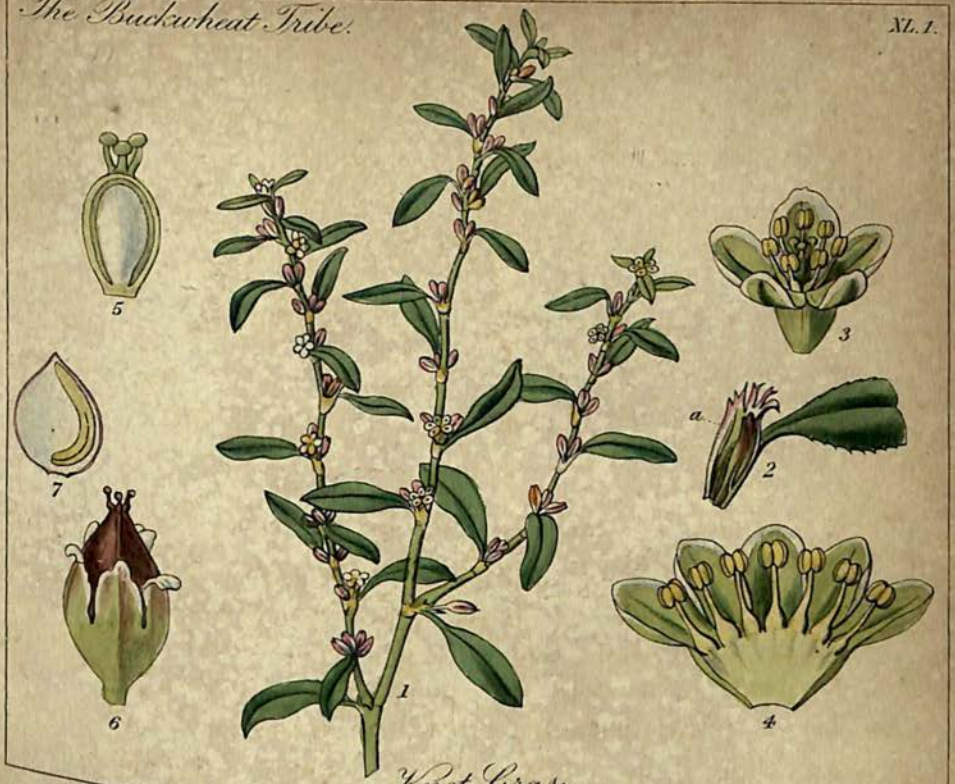
(*Plate XL.*)

No plants are more common by road-sides, and in waste places, than the species of the genera Polygonum and Rumex; or in flower-gardens, than Persicarias; or in the kitchen garden, than Sorrels and Rhubarbs. These plants belong to the BUCKWHEAT TRIBE (Polygonaceæ), and will next demand our attention.

You will, no doubt, remember the Nettle Tribe (Vol. 1. *Plate* XI. *p.* 147.), with its hairy calyxes without petals, its flowers of two sorts, and its single ovary, containing one upright seed; nor do I imagine the gorgeous Amaranths to be forgotten, whose calyx is so much like that of the Nettles, only that its colours are so gay, its flowers all of the same sort, and the leaves without stipules. The Buckwheat Tribe is in many respects like these, but at the same time essentially different. Take for an example *Knot-grass* (Polygonum aviculare), species of which are sure to be met with on every neglected garden walk, or hard bank, where few other plants could exist at all. There it expands its numerous slender arms, embracing the hard earth, and pressing to its bosom the cold rock

The Buckwheat Tribe.

XI. 1.



Knot Grass.

The Goosefoot Tribe.

XI. 2.

Common Goosefoot.

on which nothing else can grow, equally regardless of hunger and parching thirst. Nay, do not start at this strange description; it is literally as well as figuratively true.

Knot-grass (Polygonum aviculare, *Plate* XL. 1.) is one of the commonest of European weeds; wherever a seed can take root in the neighbourhood of man, and where nothing else, not even a Stonecrop, can fix itself, there you will find Knot-grass, lying prostrate on the soil, and continually spreading away from a common centre. Its stems are slender, and wiry; its leaves are narrow and oblong, with a curious pair of fringed, ribbed stipules at the base (*fig.* 2. *a.*), surrounding the stem, and forming a sort of tube through which its joints pass; such stipules, which are very uncommon, have obtained the technical name of *ochreæ* or boots. The flowers are sessile and axillary in the bosom of the leaves. They consist (*fig.* 3.) of a calyx divided into five imbricated parts, which unite at the base in an herbaceous tube. Into the throat of the tube are inserted seven stamens (*fig.* 4.), of equal length, but having no certain position with respect to the lobes of the calyx; constituting however, in theory, almost one whorl and a half. The ovary (*fig.* 5.) is an oblong, three-cornered body, with three separate stigmas, and one erect ovule in its inside. The fruit (*fig.* 6.) is a three-cornered, hard, deep-brown nut, encircled by the calyx, and containing a curved embryo lying on one side of some mealy albumen (*fig.* 7.), the radicle of the embryo nearly touching the apex of the seed.

It therefore differs from the Nettles in having booted stipules, uniform flowers, and triangular fruit, and from the Amaranths, in having stipules, triangular fruit, and an inverted embryo. There is nothing else within your acquaintance with which it is necessary to compare it. Hence the Buckwheat Tribe, the species of which, however different from Knot-grass, agree with it essentially, is a peculiar natural order, cut off by strong lines of demarcation from all that surround it.

Knot-grass itself, I have already said, is a species of Polygonum, and there are many other wild plants belonging to the same genus; of these P. hydropiper and Persicaria, with their short, rounded spikes of pink calyxes, are common examples; in the gardens P. orientale, or *Garden Persicaria*, with its crimson panicles, is one of the showiest of annuals; and in the fields *Buckwheat*, or *Beechwheat* (Polygonum Fagopyrum), so called from the resemblance of its little hard-brown seed-vessels to Beech mast, with its beautiful rose-coloured flowers, is commonly cultivated for its seeds, of which pheasants are remarkably fond, and from which is prepared the flour from which in part crumpets are made.

But these are far from all; *Docks*, the detestation of the farmer, with all their hedge varieties or species, and *Sorrels*, which the French cooks value so much, notwithstanding their unwholesome acidity, are different species of Rumer; while Rheum boasts of the useful *Rhubarbs*, whose leaf stalks afford a pleasant substitute for gooseberries in the early spring,

and of the drug of that name, which is one of the greatest preservatives that nature has provided for the delicate machinery of man.

Many other exotic plants equally belong to this tribe; but they are not worth the introduction here.

Very closely allied to the plants last mentioned, are those which constitute the GOOSEFOOT TRIBE (*Plate* XL. 2.), a natural order comprehending such culinary vegetables as *Spinach* (Spinachia oleracea), *Orach* (Atriplex hortensis), *Beet* (Beta vulgaris), and the like. They are plants whose flowers are of an herbaceous or dull red colour, and of a succulent texture, so that they all are, without exception, unattractive species. What nature has denied to their flowers, she sometimes however gives to their leaves, which are occasionally stained with the most vivid tints of yellow, purple, crimson, and even rosy red, as in the Chard Beet, and the Garden Orach. Most, and perhaps all, are suited for cooking as spinach, in consequence of the pulpy, tender, sub-mucilaginous quality of their leaves; but, as they differ in quality, Spinach itself is generally preferred for the table; none of them, however, are better than the wild *Sea Beet* (Beta maritima), which loves to fix itself on the sea-shore at the foot of chalky cliffs, often within reach of the spray.

One of the commonest species is *Goosefoot* (Chenopodium album), a grey, powdery, annual weed, which springs up on every heap of rubbish, and soon produces at the ends of its upright branches numerous clusters

of minute green flowers (*Plate* XL. 2. *fig.* 1.), which, without changing colour, ripen their seeds, and drop them in profusion on the surrounding soil. It is scarcely possible to select a plant more unattractive than this, and yet, if you will attentively study its structure with me, you will find that, in some respects, its beauty is of no common order.

I have already said that it is an annual; its stems are angular, and grow about a foot and a half or two feet high, producing a few stiff upright branches. The leaves are of a dull grey green on the upper side, and of a dead glaucous colour on the under side; they are, moreover, powdered with a loose mealy substance, which spreads indeed over all the parts of the plant exposed to the air, and which seems to be a peculiar cutaneous secretion. Viewed under the microscope, and illuminated by a ray of bright light thrown from above, this secretion gives the plant the most beautiful glittering appearance, every part of the surface being spangled with what seem fragments of emeralds and chrysoprases. The leaves are placed on short stalks, and they have a somewhat lozenge-shaped figure, with several coarse toothings on their edge.

The flowers are arranged in compact clusters, proceeding from the axils of the leaves. Each, when unexpanded (*fig.* 2.), is round, depressed, marked with five prominent, rounded angles, bright green, exquisitively studded in the hollows between the angles with little glittering balls, which have all the appearance of being consolidated dew; indeed the whole flower-bud has much the aspect of a tiny green *sea-egg*

(Echinus). All this pretty show belongs to the calyx, which finally unfolds into five, spreading, pale green lobes (*fig.* 3.), with a white pearly border. There are no traces of petals. The stamens are five, slightly adhering by their bases into a very shallow cup, and placed opposite the divisions of the calyx. The ovary (*fig.* 4.) is roundish, superior, with two long hairy stigmas, it is one-celled, and contains a single ovule, attached to the bottom of the cell by an oblique cord (*fig.* 5.). The seed-vessel is a thin semi-transparent bag, which breaks irregularly when ripe, and drops a single jet-black flattish seed (*fig.* 6.), containing an embryo, curved round mealy albumen, and pointing its radicle to the hilum (*fig.* 7.).

In general, plants of the Goosefoot Tribe are so similar to this in structure, as to give the student no trouble in identifying them; some, for example, have the stamens in one flower, and the pistil in another, as Spinage; others have the base of the calyx hardened and partially adhering to the ovary, as Beet; but such differences are no greater than occur in all natural orders. There is, however, a wild plant belonging to the Goosefoot Tribe, which is so curious in its appearance, as to deserve particular mention. It is often brought, from the salt-marshes where it grows, to market, under the erroneous name of Samphire,* and being prepared with spice and vinegar, forms a coarse kind of pickle. At first sight you would take this plant, whose real

* The real Samphire is an Umbelliferous plant, found on the chalky cliffs of our southern coast; it is the Crithmum maritimum of Botanists.

name is *Glass-wort* (Salicornia), to be leafless and flowerless, with nothing but jointed brittle stems; for its shoots really look as if they were formed only of joints of different lengths strung together. Upon looking, however, at the upper end of the joints you will find that each has a pair of opposite slightly prominent expansions, which stand in the room of leaves; and at the end of some of the shoots these expansions are closer together, more evident, connected with shorter joints, and altogether produce the appearance of slender cones. Still no flowers meet the eye. But above each of the joints of the cones, you may remark three minute scales, placed in such a way as to form a triangle; if with a fine pointed instrument you gently remove one of the scales, you will find below it, in a little niche, an ovary with a short ragged stigma, and one, or, occasionally, two stamens. This is the flower, of which the external scale is all that remains to represent the calyx. The seed and seed-vessel are something like those of Chenopodium, only the former is hairy.

In Salicornia the ordinary structure of the order is, you perceive, interfered with, by the imperfect formation of the leaves and calyx, by the number of stamens being fewer than usual, and by the peculiar structure of the jointed stems. In some other genera the aspect of the plants is changed by a curious peculiarity in the calyx; in one plant, when the seed is ripe, that part is succulent, and richly coloured with crimson, and as the flowers grow in compact clusters, the calyxes, readily adhering, form small balls, with much the appearance of Strawberries, whence such

plants are called *Strawberry Blite* (Blitum). In others, the calyx, at the angle where it bends over the seed-vessel, expands into membranous wings, giving the whole plant a very singular appearance; this occurs in *prickly Saltwort* (Salsola Kali), a common plant on the sands of the sea coast in some parts of this country, and sometimes collected for the sake of its ashes, which yield common soda in abundance. A tendency to this enlargement of the calyx exists even in common Beet, whose seed-vessel is surrounded by the calyx, half in a hardened, half in a spongy state.

Having thus made yourself mistress of the peculiarities of the Goosefoot Tribe, let me recommend you to contrast them with the Nettle Tribe, the Buckwheat Tribe, and the Amaranth Tribe, because all those are, in reality, very closely allied to it. Parallel columns had better be again employed for comparing their differences—

Nettle Tribe.	Buckwheat Tribe.	Amaranth Tribe.	Goosefoot Tribe.
Stipules membranous and distinct.	Stipules membranous and ochreate.	Stipules o.	Stipules o.
Flowers of two sorts.	Flowers of one sort.	Flowers uniform, dry, membranous, and surrounded by bracts.	Flowers either uniform, or of two sorts, soft, succulent, and not surrounded by bracts.
Seeds round. Radicle at the point of the seed.	Seeds triangular Radicle at the point of the seed.	Seeds round. Radicle at the base of the seeds.	Seeds round. Radicle at the base of the seed.

Hence it appears that the Nettles and Buckwheats have stipules, and the radicle at the point of the seed;

while the Amaranths and Goosefoots have no stipules, and the radicle at the base of the seed. At the same time the Buckwheats differ from the Nettles in having ochreate stipules, uniform flowers, and triangular seeds; while the Goosefoots differ from the Amaranths in having herbaceous, succulent, naked flowers, and in very little else. For this reason some persons would combine the two latter Natural Orders ; but they are recognized as distinct by almost all Botanists.

EXPLANATION OF PLATE XL.

I. The Buckwheat Tribe.—1. A piece of *Knot-grass* (Polygonum aviculare).—2. A single leaf with its ochreate stipules, *a*, which are rent asunder by the expansion of the stem that they surrounded. —3. A flower.—4. The same split open, shewing seven stamens, arising from a fleshy tube of the calyx.—5. An ovary cut open, shewing the three stigmas, and the single erect ovule.—6. A ripe seed-vessel, or nut, invested by the remains of the calyx.—7. A section of the seed, shewing the embryo lying on one side of the mealy albumen.

II. The Goosefoot Tribe.—1. A twig of *Goosefoot* (Chenopodium album).—2.—A flower before unfolding.—3. An open calyx, with the stamens and ovary.—4. An ovary, with the two stigmas.— 5. The same cut open, and shewing the ovule resting on its end.— 6. A seed, with the torn remains of the membranous seed-vessel investing it.—7. A section of the seed, shewing the curved embryo, and the mealy albumen in its centre.

The Mezereum Tribe. XLI. 1.

Common Mezereum.

The Cinnamon Tribe. XLI. 2.

Sweet Bay.

LETTER XL.

THE MEZEREUM TRIBE—THE CINNAMON TRIBE.

Plate XLI.

It is by no means an unusual thing for the prettiest and most splendid species of the vegetable kingdom to conceal the deadliest qualities. Rhododendrons, Azaleas, and Kalmias, in the Heath Tribe, Blood-flowers (Hæmanthus) and Crinums in the Narcissus Tribe, Foxglove in its own tribe, and Ranunculuses, Aconites, and Larkspurs, in that of the Crowfoot are familiar instances of this; to which you now may add that of the various pretty species of the Mezereum Tribe. The plant from which the name is derived (Daphne Mezereum), the *Spurge Laurel* (Daphne Laureola), the lovely *trailing Cneorum* (Daphne Cneorum), and various other species of the same genus, together with the Gnidias, and Struthiolas of the greenhouse, are all acrid, suspicious plants, and in some instances extremely dangerous. The berries of the Mezereum and the Spurge Laurel are fatal poisons to man, although birds feed upon them uninjured; the bark of all the species is so acrid, that if moistened and bound down upon the skin it raises blisters, and even the perfume of those which have fragrant flowers will often produce fainting in persons with delicate nerves.

The ingenuity of the fair sex has not failed to profit by these qualities, for the Tartar ladies, availing themselves of the acrid property of the Daphne leaves, rub them over their cheeks instead of rouge, to raise a gentle colour in the skin.

All this while I am talking of these plants as if you knew them, and I think it impossible but some of them must have been already seen by you. Spurge Laurel is a common evergreen in shrubberies, with deep green, shining leaves, little pale green flowers, almost concealed by the leaves, and black drupes resembling those of the common Laurel (Prunus Laurocerasus) externally.

Still more common is Mezereum, and much more striking, for it bears its rose-coloured or white flowers upon naked branches late in autumn or early in the spring, and at that time there is no shrub that at all resembles it. We will take this species for examination. The rosy flowers do not owe their colour to the presence of petals, but are merely composed of a calyx (*Plate* XLI. 1. *fig.* 2.), having four spreading lobes half-united in a tube, hairy externally and slightly pitted all over the inner surface. This arises from the looseness of the parenchyma which connects the two surfaces of the calyx, and which is so easily disturbed, that you may without difficulty separate the whole of the inner from the whole of the outer surface, dividing the calyx into two cups. Hence it has been thought by some, that in reality the calyx and corolla are really both present in Daphne, but naturally glued together. Such an opinion is however neces-

sarily unfounded, as will be obvious to you, if you call to mind the rule I sometime since explained to you (page 131), that all the parts of a flower naturally *alternate* with each other. Nevertheless, M. Dunal, a French Botanist, has founded upon this and some other cases, a theory of *unlining* in flowers (*dédoublement*), imagining that in all cases the corolla is produced by an unlining of the calyx!

But to return to our Mezereum. Eight stamens in two rows, one above the other, are placed on the tube of the calyx; and at the bottom of the cup is a superior one-celled ovary (*fig.* 2.), with a nearly sessile, tufted stigma (*fig.* 3). In the inside of the ovary hangs a single ovule (*fig.* 3. *c.*), with a foramen (page 73, and *fig.* 3. *b*), so conspicuous, that it may be almost seen by the naked eye. When you first pull the ovary of the Mezereum in pieces you will probably imagine that the ovule is enveloped in a loose hairy bag (*fig.* 3. *a.*); but upon scrutinizing it more narrowly, you will find that the supposed bag is merely the lining of the ovary, which readily separates from the shell and clings more or less to the ovule; so that you see the disposition to *unline*, which is found in the calyx, is also conspicuous in the ovary. A section of the ovary, carefully made in a vertical direction (*fig.* 3.), exhibits this very clearly, presenting the appearance of two cavities, one above the other, the upper one smooth and containing the ovule, the lower one bristling with crystalline points, and empty.

The ripe fruit of Mezereum is red and succulent

(*fig.* 4.); it has a slight depression at the point where the stigma was, and it contains a single suspended seed (*fig.* 5.). The embryo is a large almond-like (*amygdaloid*) kernel, with two fleshy plano-convex cotyledons, and a radicle pointing to the apex of the fruit (*fig.* 6.).

All the genera you are likely to meet with, belonging to the Mezereum Tribe, are very like the above in nearly every respect; the most important differences to remember, are, that some of them, as Gnidia, have little scales in the mouth of the calyx, and that it is only in a few that the fruit is succulent: more generally it is hard, dry, and nut-like.

You have before had instances of the toughness of the bark of plants, and of its fitness to be manufactured into cordage or similar materials. All the Daphnes, and indeed the Tribe, partake of this quality; they are, however, chiefly known for the production of paper and lace. In China and India, a coarse paper is manufactured from the inner bark of two or three species; and in the West Indies, Nature produces a beautiful description of lace in that of another kind. You seem incredulous; and yet I know not wherefore you should be, considering how many greater wonders you have already witnessed among plants. I repeat it, in Jamaica a natural lace, of fine quality, is produced ready manufactured, in the bark of the Lagetto Tree; so fine, indeed, that ruffles, a frill, and cravat were cut from it, and sent as a present to King Charles II. This substance is not so often seen in England as its beauty and curiosity would

have led one to expect; in Jamaica it is well known, and, by a little contrivance, the most beautiful brushes are readily prepared from it. In reality it consists of the thin layers of the inner bark of the tree, a little stretched sideways, so as to separate the parallel fibres, and to give their meshes a lozenge form. Botanically considered, it is the very same substance as that from which are manufactured the common Russia Mats, in which furniture is packed, and of which Gardeners make use under the name of *Bast;* only instead of being coarse and brown, it is extremely fine and white.

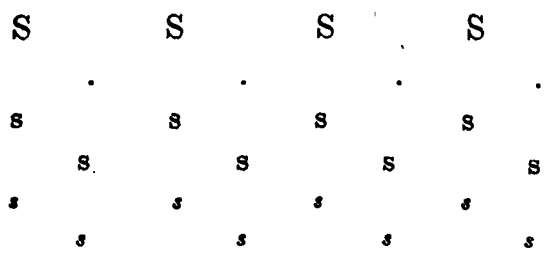
It is not a little curious, that of the reputed Laurels so very common in gardens, namely, the Common Laurel, the Portugal Laurel, the Spurge Laurel, the Alexandrian Laurel, the two first should be Cherries, the third a Daphne, the fourth a Ruscus, and not one of them in truth a Laurel; while, on the contrary, a species of true Laurel, actually cultivated very commonly, is not recognized popularly, but has the name of *Sweet Bay.* For this reason, although it would have been more correct to have called the assemblage of plants to which the latter belongs the Laurel Tribe, yet, to avoid confusion, it is better to drop the name Laurel altogether, and to designate the plants by a title about which there can be no mistake. We will, therefore, call the Lauraceous plants of Botanists the Cinnamon Tribe, because the aromatic spice of that name is yielded by some of the species, and

because an aromatic principle, of an analogous kind, is found throughout the remainder.

These useful and valuable plants are most curious in their structure, as the *Sweet Bay* (Laurus nobilis) will shew you. It is, as you are aware, a hardy evergreen bush, whose leaves when bruised, give out a grateful spicy odour, and which are in consequence extensively used in making pastiles and sweetmeats. It grows wild in the south and middle of Europe, especially in France and Italy, where it is a great ornament of scenery.

The flowers break out of little brown scaly balls, in the axils of the leaves (*Plate* XLI. 2. *fig.* 1.), are of a pale cream colour, and have the following structure. The calyx is divided into four deep lobes, which spring from the top of a hairy stalk (*fig.* 2. & 4.). There are no petals. Some flowers are sterile, some fertile. The sterile flowers (*fig.* 2.) contain eight stamens of a most singular nature; each has a flat, linear filament, with a stalked, kidney-shaped gland, growing from each side near the base (*fig.* 3. *c.*), and a two celled anther, the valves of which separate from their cells, like those of the Barberry (page 12.), and curve back by a sort of hinge at the upper end of each cell. It is found by the structure of other genera, that the kidney shaped-glands are abortive stamens; consequently, in this apparently simple flower, there is an irregularity of a very extensive kind, four petals and sixteen stamens being either abortive or rudimentary, as is expressed by the following scheme.*

*See page 132.



In the fertile flowers (*fig.* 4.) there are only four imperfect stamens, each with two, small rounded lobes in the middle, and a superior ovary containing a single cell, and terminated by a style surmounted by a dilated, purple, glandular stigma (*fig.* 5.); it contains a single suspended ovule. The fruit, when ripe, is ovate, black, and succulent (*fig.* 6.), and contains a single seed, with a thick, almond-shaped *amygdaloid* embryo, whose radicle points to the apex of the fruit (*fig.* 7. & 8.).

It will be plain to you at once that this plant corresponds in every respect with the Mezereum Tribe, as in the absence of petals, the number of lobes of the calyx, the number of perfect stamens, and the whole structure of the ovary and fruit. But, on the other hand, it differs in the presence of so many abortive stamens, in its anthers with recurved valves, and its aromatic qualities. It is, however, well worth notice, that although we use Cinnamon and Cassia habitually in small quantities, yet that this Tribe possesses in abundance a powerful acrid juice, which assimilates its secretions very much to those of the Mezereum Tribe.

The genera differ chiefly in the number, form, and position of the abortive stamens, in the number of cells

of the anther, in the form, &c. of the calyx, and some other minor circumstances. They are, however, so seldom seen alive in Europe, in a flowering state, that I need not occupy your time about them. Consider them aromatic Mezereum-like plants, with anthers bursting by recurved valves, and you cannot easily forget them.

EXPLANATION OF PLATE XLI.

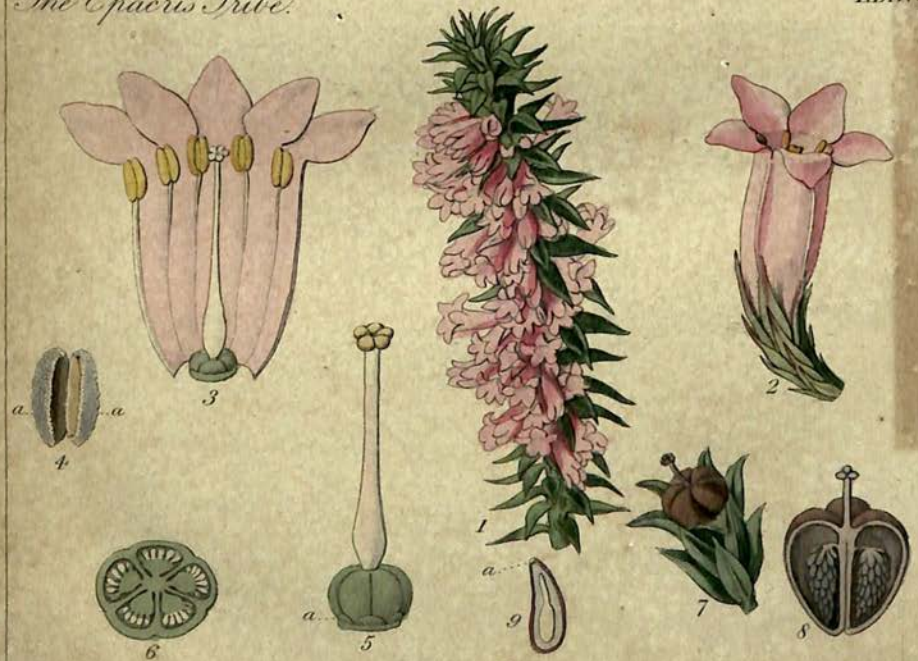
I. The Mezereum Tribe.—1. A twig of *common Mezereum* (Daphne Mezereum).—2. One of its calyxes cut open, and shewing the stamens and ovary.—3. An ovary cut perpendicularly, to shew the cavity *a* in the pericarp, the ovule *c*, and its foramen *b*.—4.* and 5.* stamens.—4. A cluster of ripe fruit, natural size.—5. A section of a fruit, shewing the seed.—6. The embryo.

II. The Cinnamon Tribe.—1. The *Sweet Bay* (Laurus nobilis).—2. A sterile flower, with its 8 glandular stamens.—3. A stamen separated; *a* one of the valves of the anther, *b* another quite rolled back, *c* abortive stamens, resembling glands.—4. A fertile flower, with the four abortive stamens surrounding the ovary.—5. A section of the ovary.—6. A ripe fruit.—7. A longitudinal section of the same, shewing the radicle at the apex.—8. A transverse section of the same, shewing the two cotyledons cut across.

The Primrose Tribe. XLII. 1.

The Cowslip.

The Epacris Tribe. XLII. 2.



Pink Epacris.

LETTER XLI.

THE PRIMROSE TRIBE—THE EPACRIS TRIBE.

Plate XLII.

THE Primerose, *Primrose,* or First Rose of Spring, the *Cowslip,* the *Oxlip,* the *Auricula,* or Powdered Beau, are so associated with our earliest recollections as children, that we never, to the last hour of our existence, entirely cease to look upon them with pleasure. Nor indeed is it possible, independently of all our remembrances of infancy, to behold without delight a sunny bank all light and life with tufts of sweet yellow flowers, when nature elsewhere remains in the garb of death and winter.

All these pretty plants are so well known to you, that I might as well have left you to study them by themselves, without any remark beyond what has already been made upon a former occasion (Vol. 1. p. 187.), if it were not my wish to illustrate in detail every natural assemblage that is common enough to be likely to fall in your way. Leaving you then to refer to our correspondence for the general facts connected with the PRIMROSE TRIBE, let us carefully note down the structure of the Cowslip blossom (*Plate* XLII. 1.).

You know that the flowers grow in little nodding clusters, or umbels, from the top of a round, brittle

stalk, which raises them above the low herbage that surrounds them. Each has a tubular, angular, pale green calyx, with five teeth corresponding with the projecting angles. The corolla (*fig.* 2.) is monopetalous, salver-shaped (that is with a cylindrical tube and flat border), and a little contracted near the middle of its tube; its border is divided into five lobes each of which is slit or notched at the end. The anthers are almost without filaments, and stand side by side half way down the tube of the corolla; not, however, alternately with its lobes, as usually happens, but opposite to them. Perhaps you will not very readily ascertain this without assistance; either of two modes will enable you to do so. Look down into the tube without disturbing any of the parts, and you will then see that each stamen stands in front of a lobe of the corolla; or, if this does not satisfy you, cut open the corolla, hold it against the light, and you will then see that each anther stands upon a delicate, half-transparent vein, which passes through the middle of a lobe of the corolla (*fig.* 2.). This is an important fact, for two reasons. In the first place, it enables you to distinguish a plant of the Primrose Tribe with certainty from all other monopetalous tribes, except one; and secondly, it indicates a great degree of irregularity in the flower; for by the rule I have lately given you (page 132.) it appears, that, simple and unchanging as the Cowslip flower apparently is, it really has five of its stamens, namely, the first row, absent, those which make their appearance belonging to the second row.

The only other monopetalous tribe in which the stamens are opposite the lobes of the corolla, is the Myrsinaceous, to which belong the Ardisias, so frequently seen in stoves; but all these are exotics, and are bushes or trees, by which circumstance they are at once known from the Primrose Tribe, without taking other circumstances into account.

The ovary of the Cowslip (*fig.* 5.) is a superior hollow case, of a top-shaped form, and marked by ten longitudinal furrows, of which five are more conspicuous than the others; it is surmounted by a slender thread-shaped style, which terminates in a round pin-headed stigma. From the number of furrows on the outside of the ovary you would naturally expect that it should contain five cells; but upon opening it you can only discern a single cavity, with a free central placenta (*fig.* 6. *a.*), loaded with ovules in the middle. If, however, you were to dissect the ovary, when very young, you would then find five cells cut off from each other by five partitions; but long before the flower opens these partitions are broken and disappear, and the consequence is that the placenta grows up in the middle without any connection with the sides of the ovary.

The fruit of the Cowslip is well worth an attentive study. It is invested with the dry, dead, but firm and little altered calyx (*fig.* 7.), at the bottom of which stands a seed-vessel that splits at the point, with ten teeth which turn backwards to allow the seeds to fall out; its centre is occupied by a brown hard cone, over which the seeds are closely arranged. Each seed

is a little, rough, deep-brown, angular body (*fig.* 8.), adhering to the placenta by the middle; and containing a dicotyledonous embryo lying across the hilum (*fig.* 9.); that is, not turning to the hilum either the radicle or the end of the cotyledons.

The genera of the Primrose Tribe are very distinctly marked. Cyclamen or *Snowl read,* for instance, has the lobes of its corolla bent back, and when the flower is past it gently twists its penduncle till it becomes so short as to bury the tough leathery seed-vessel in the earth. This is a most curious economy, the cause or object of which is quite unknown. Anagallis, or the *Pimpernel,* has the corolla divided into five deep lobes, and its seed-vessel opens by a lid like a little soap-box. Hottonia or *Water-violet,* with its feathery leaves, and beautiful pink flowers, has a five-parted calyx, the corolla of a Primrose, and a round seed-vessel, with five compact valves. *Brookweed* (Samolus Valerandi), with its tassels of small white flowers, has a partially inferior ovary, and five additional rudimentary stamens in the form of tapering threads. And the remainder are equally easily recognized.

And now you know as much about the Primrose Tribe, in general, as it is necessary for me to tell you in this correspondence; for the rest you will, of course, refer to systematic works. I must, however, before I quit the subject, tell you of one delicate, tender, little, lovely thing, that is seldom seen, except by Bōtanists, but which you might easily cultivate in your window, under a bell-glass. This is the Bog Pimpernel; a small, trailing, light green plant, with stamens only a

few inches long, and covered with tiny roundish leaves, most beautifully dotted on the underside. The flowers of this plant are little rose-coloured bells, standing upright upon slender stalks, which afterwards curve downwards to bury the fruit. Its stamens are so thickly covered with the most delicate, glittering, jointed entangled hairs, that they look like five yellow anthers, standing on the top of a tuft of silver wool. Where the Sun-dew, Parnassia, Butterworth, and all those curious little bog plants occur, there you will be sure to meet with this charming species, which Botanists have truly called the *delicate* (Anagallis tenella), for we have no more fragile flower in all our British Flora.

From these we turn to plants so like the Heath Tribe (Vol. I. page 158. *Plate* XII. 1.) that it is useless for me to do more than point out in what they differ. I am adverting to the Epacris Tribe. In the smallness of their leaves, the brittleness of their stems, their uses to man and the gayness of their flowers, in the clearness and brilliancy of their colours, and in general points of organization, in short, in all that can strike the casual observer, the two tribes are alike; one being the pride of Europe and Africa, the other the glory of the hills and wastes of the Australian continent and islands. Several species are common in greenhouses, particularly of the genus *Epacris*, with their bells of pink, or red, or white, of *Styphelias* and *Dracophyllums*, with their long tubes of crimson and other colours, or of *Whitebeards* (Leucopogons), with the

mouths of their corolla stuffed with snow-white hairs. The *Pink Epacris* (Epacris ruscifolia, *Plate* XLII. 2. *fig.* 1.) is one of the easiest to procure.

It forms a slender heath-like plant, with stiff ovate, sharp-pointed leaves, in the bosoms of the uppermost of which the flowers are closely arranged upon short stalks, covered completely by scale-like bracts (*fig.* 2.), which one can hardly distinguish from the five-leaved calyx. The tubular bellshaped corolla, with a short, spreading, five-lobed border, the superior ovary with five many-seeded cells (*fig.* 6.), the hypogynous scales, (*fig.* 5. *a.*), the single style, the obscurely lobed stigma, and, finally, the dry seed-vessel, containing a vast quantity of minute seeds (*fig.* 8.), are all characters in accordance with those of the Heath Tribe. But in the stamens there is a material difference; they arise from the side of the corolla, (*fig.* 3.) in this species, but sometimes they agree with the Heath Tribe in growing from below the ovary: the anthers are always one-celled, opening by two valves (*fig.* 4. *a.*), and never two-celled, opening by five valves, or two pores. It must be confessed, these are not points of much importance, but Botanists seem generally agreed upon recognizing the EPACRIS TRIBE as distinct from that of Heaths, and we may as well swim with the stream, as it is really of no practical importance whether the Epacris Tribe is considered a distinct assemblage, or a mere section of the Heath Tribe.

In general, both the Epacris and Heath Tribes have a dry seed-vessel; but as we have the succulent Arbutus and Cranberry among the latter, so we have

the *Australian Cranberry* (Lissanthe sapida and Astroloma humifusum), and *Van Diemen's Island Currants* (various Leucopogons) among the former.

EXPLANATION OF PLATE XLII.

I. The Primrose Tribe.—1. A cluster of *Common Cowslip* (Primula veris) flowers.—2. A corolla opened to shew the position of the stamens, with respect to the lobes of the corolla.—3. A calyx with a portion cut away to shew the ovary, style, and stigma.—4. A stamen.—5. A pistil very much magnified; in this figure the furrows of the ovary, and the glandular hairs of the style, are distinctly seen.—6. A cross section of an ovary, with the free central placenta at *a*.—7. Half a seed-vessel, invested with the calyx; *a a* are the teeth-like valves by which it opens, and *b* the central free placenta covered with seeds.—8. A ripe seed, much magnified; *a* the hilum.—9. A section of the same shewing the embryo lying in hard albumen; *a* the hilum.

II. The Epacris Tribe.—1. *Pink Epacris* (Epacris ruscifolia).—2. A flower with the scale-like bracts that cover its stalk.—3. A corolla cut open, shewing the stamens, ovary and style.—4. A one-celled anther opening by two granular valves, *a a*.—5. A pistil, with five scales *a*, surrounding the base of the ovary.—6. A cross section of the ovary, shewing the five cells, and many-seeded placentæ.—7. A fruit of Epacris (after Gærtner).—8. A section of it shewing the placentæ and seeds.—9. A seed cut in half lengthwise, shewing the embryo lying in albumen, with the radicle turned to the hilum.

LETTER XLII.

THE GREEK VALERIAN TRIBE—THE TRUMPET-FLOWER TRIBE.

(*Plate XLIII.*)

When we were studying the Bindweed Tribe (Vol. I. *p.* 161.), I neglected to mention a set of common plants, closely allied to it, but in general not twiners; namely, the Greek Valerian Tribe, or Polemoniaceous Plants. Let me now proceed to supply that omission.

You cannot but be acquainted with the genus *Phlox*, or, as the old gardeners called it, Lychnidea, the species of which are among the showiest of common perennials, whether they rise erect from the ground with broad, deep-green, opposite leaves, and dense clusters of purple flowers, terminating the branches, or lie prostrate among rock-work, with their slender stems covered by sharp scales, and a few neat lilac or white blossoms just raising themselves from the soil.

Cobæa is another well known genus, that overruns the forests of Mexico with its annual stems, and which, on that account, has been long since transferred to the gardens of this country, where it will grow between two and three hundred feet in a single summer, completely hiding a large extent of treillage with its

The Greek Valerian Tribe. XLIII. 1.

Many-coloured Slender-tube.

The Trumpet-flower Tribe. XLIII. 2.

Rooting Trumpet-flower.

blueish green leaves, and huge, bell-shaped, dingy, greenish purple blossoms.

With these, Botanists associate the *Gilias*, with their heads of blue, or red, or party-coloured flowers, and finely-cut leaves, the *Collomias* with their small buff or brick-red blossoms, peeping from among close glandular bracts, *Ipomopsis* with its innumerable pendent tubes of scarlet and gold, and the *Greek Valerians* (Polemonium), or *Jacob's Ladder* plants, the old-fashioned gardeners' pets, with their spreading fern-like leaves, and nodding bells of blue or white.

We will, however, study none of these. Let us rather examine a plant of this charming annual lately imported by the Horticultural Society from California, (*Plate* XLIII. 1); it is called *Many-coloured-Slender tube* (Leptosiphon androsaceus). Observe how delicately it is frosted by little glandular hairs; millions of millions of these bodies must be perpetually employed in separating from the blood of the Slender-tube the matter which Nature requires it to part with. Its leaves are divided into deep narrow lobes, which all spring from near the same point. Its flowers stand in an umbel, at the end of a slender stalk, and have their bases buried among narrow green bracts. Each calyx (*fig.* 3.) has five, narrow, sharp-pointed, hairy lobes, connected into a short tube by a thin web (*fig.* 3. *a.*). The corolla has a slender, reddish-brown tube, with a spreading, five-lobed, pale, lilac border, yellow at the base, and within the tube deep-chocolate brown (*fig.* 2.). It has five anthers, stationed on short filaments at the orifice of the tube,

and projecting a little way beyond it. The ovary is superior, contains three cells (*fig.* 5.), in each of which are about six ovules adhering to a placenta in the axis. The style is thread-shaped, and terminated by three narrow lobes (*fig.* 3.). The seed-vessel (*fig.* 6.). opens into three valves, bearing the dissepiments in their middle. The seeds are spongy, oval bodies (*fig.* 7.), with a thick skin, and contain an erect embryo (*fig.* 8.) without albumen.

If you contrast this with a Bindweed, you will remark that in that plant, the corolla has its lobes plaited together, the stigma two-lobed, more or less, while here the lobes of the corolla are imbricated, and the stigma three-lobed. These distinctions are the most material for separating the two tribes, for we cannot make great use of the twining habit of the Bindweeds, first, because *Cobæa*, which is of the tribe now under consideration, also twines, and, secondly, because many Bindweeds do not twine.

I have already adverted to the existence of a genus called Collomia; it consists of species of little beauty; but in one of them, Collomia linearis, the microscope reveals one of the most marvellous phenomena I am acquainted with. The seeds of this plant are small, dry, hard, and brown. If you look at them ever so carefully while dry, you will find nothing that can lead you to suspect the existence, in their skin, of any peculiar mechanism. But place them under a microscope, and, while watching them, gently float them in water. In a few moments the fluid will appear in rapid motion, thousands of silvery threads will be

seen lancing themselves into the water, and unrolling in all directions, and the whole field of the microscope will, on a sudden, present a spectacle of action, life, and movement. This is owing to the expansion of a vast quantity of spiral threads, which, when dry, are contracted and glued to the surface of the seed, but which are suddenly set at liberty upon the application of water.

Another set of plants, that I must bring you acquainted with, is the TRUMPET-FLOWER TRIBE You have long since studied the Foxglove Tribe, and you remember that it consists of herbs, with an erect habit, and little angular, or round seeds, the embryo of which is surrounded by albumen. Very nearly akin to these are certain exotic plants, most of which are trees or shrubs, with flowers like those of the Foxgloves in all respects, only that they are usually larger, in most instances with a twining or climbing mode of growth, and with large flat pods, some of which are as much as two or three feet long, filled with flat thin-winged seeds, containing an embryo without albumen.

The common genus of these plants is named Bignonia, or the *Trumpet-flower*, whence the Tribe has gained its usual designation. All that belong to it are climbing plants, as is indeed every species common in gardens, except the noble *Catalpa* (Catalpa syringifolia), which forms a tree as large as an apple tree, and almost as hardy, its boughs loaded in summer with heaps of magnificent white and lilac flowers,

The other trees of the Tribe are, with the exception of Jacaranda, with their airy, graceful, fern-like foliage unknown in Europe in a living state; they inhabit the forests of India and America.

The *Rooting Trumpet-flower* (Bignonia radicans), is so very common, that there is hardly a village in England where some garden does not contain it. We will, therefore, select it for study. Mr. Elliot tells us, that it is common in the damp rich soil of Carolina, "climbing over buildings and the loftiest trees, throwing out radicles all along the stem, by which it attaches itself firmly to walls, fences, and the bark of trees." In this country it is much less vigorous, owing no doubt to the greater coldness and dryness of our climate. It has opposite pinnated leaves, the leaflets of which are ovate, taper-pointed, and sawed (*Plate* XLIII. 2. *fig.* 1.). Its flowers, of the richest brown-red or blood-red, and of a fleshy consistence, grow in clusters from the ends of short stiff peduncles. The calyx is a fleshy cup, divided into five sharp, somewhat triangular teeth. The corolla is funnel-shaped, between two and three inches long, with a border divided into five roundish, rather unequal lobes. Five stamens spring from the tube of the corolla; of these, two are longer than two others, all four being furnished with diverging sharp-pointed anthers, and the fifth (*fig.* 2. *a.*) is merely a rudimentary tooth, analogous to what you find in the flower of a Pentstemon. The ovary is seated upon a thick, yellow, fleshy cushion or disk (*fig.* 3. *a.*), and consists of two cells, containing many

ovules spread over the surface of a central placenta (*fig.* 4.). The ovary gradually tapers into a stiff, curved style, ending in a stigma composed of two thin plates.

Thus far the Bignonia is so like a plant of the Foxglove Tribe, that no Botanist can point out a distinction. It is otherwise with the fruit; in this species it is described as a very long tapering pod, filled with winged seeds; in other species its seeds are as follows: a somewhat wedge-shaped, rounded, flat centre (*fig.* 5.), comprehending a two-lobed embryo, without albumen (*fig.* 6.), is surrounded by a thin, delicate membrane, or wing, the whole substance of which consists of small, semi-transparent cells, round the sides of which is twisted a spiral, silver thread. It is here that the great difference between the Tribes of Foxglove and Trumpet-flower resides. The former has no wing to its seeds, nor any thing like the form of a long pod in its fruit. Remembering this then, you never need confound the one with the other.

Eccremocarpus scaber, is one of the prettiest of the Bignonia Tribe. From the hedges and thickets about Valparaiso, it has been transferred to our gardens, where it survives moderate winters without injury. The curious rough pods of this plant produce an abundance of the winged seeds of the Bignonias, and are well worth a careful examination.

EXPLANATION OF PLATE XLIII.

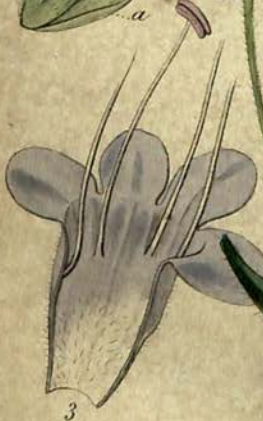
1. The Greek Valerian Tribe.—1. A cluster of the flowers of the *Many-coloured Slender-tube* (Leptosiphon androsaceus).—2. The tube of a corolla cut open, to show the origin of the stamens.—3. The calyx, style, and stigmas; *a* the membranous web that connects the lobes.—4. A longitudinal section of an ovary.—5. A transverse section of the same.—6. A ripe capsule, much magnified.—7. A seed.—8. The same cut through longitudinally, to show the embryo.

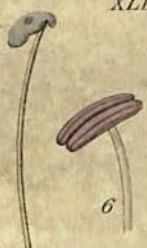
II. The Trumpet-Flower Tribe.—1. A cluster of flowers of the *rooting Trumpet-flower* (Bignonia radicans).—2.—A portion of the tube of the corolla, cut open to shew the origin of the stamens; *a* the fifth rudimentary stamen.—3. The pistil; *a* its disk, *b* the ovary.—4. A transverse section of the ovary.—5. A ripe seed of Bignonia indica.—6. Its embryo; *a* the two-lobed cotyledons, *b* the radicle.

The Madder Tribe. XLIV. 1.

Cleavers or Goose-grass.

The Scabious Tribe. XLIV. 2.





Devil's-bit Scabious.

LETTER XLIII.

THE MADDER TRIBE—THE SCABIOUS TRIBE.

(*Plate XLIV.*)

Your old housekeeper is right; on this occasion she proves a better Botanist than her mistress. There is no danger whatever in using Goosegrass for a sieve; and it is quite true that it was formerly so employed, until the cheapness of wire-work superseded it. Only take a handful of the dry stems, press them into a bowl without a bottom, or into a colander, and pour over them any thing you have a mind to strain. You will see that the liquid will come away as clear as if it had been poured through a sieve. Goosegrass possesses this property in consequence of its surface being covered over with myriads of fine hairs, hardened and curved by the hand of nature into hooks (*Plate* XLIV. 1. *fig.* 4 & 7.) which catch up and hold fast whatever may float in water, with just as much certainty as it would be intercepted by the close meshes of a sieve. As to its harmless qualities, you need have no fear upon that score, if you remark its near affinity to the Honeysuckle and Coffee Tribes (Vol. I. *p.* 176). Let me just note down the principal points that are worthy of notice in its structure.

Goosegrass, *Cleavers*, *Whiptongue* (Galium Aparine),

or whatever else its name may be, is a herbaceous plant, usually growing in hedges and dry ditches, where its long, angular, brittle stems can readily find something to catch hold of, so as to be supported a little above the earth. The angles of its stem, the upper surface and edges of its leaves, and its fruit, are closely beset with the hard, stiff, hooked hairs, above referred to; they catch hold of the clothes of the passer-by, and adhere to him like a bur, on which account the Greeks used to call this plant the *Philanthropist*. The leaves are arranged six, seven, or eight, in a whorl; they are of a narrow figure, somewhat broader towards the upper end, terminate in a hard, spiny point (*fig.* 7. *a*), and have no stipules. The flowers grow from the bosoms of the uppermost leaves of the branchlets, in the form of tiny, white, four-rayed stars. The calyx is the slightest little edge that you can imagine, placed on the top of a small hairy ball, which is the ovary. The corolla (*fig.* 1.) is valvate and monopetalous, but almost divided into four parts, so slight is the degree of connection between the petals. From the recesses of the corolla spring four stamens (*fig.* 1. & 2.). The ovary is a round, inferior, hairy ball, containing two cells, in both of which is one ovule, rising up from a very short stalk (*fig.* 2.); it is surmounted by two styles, each bearing a single round stigma. On the outside of the styles, between them and the corolla, is a green, fleshy, two-lobed disk (*fig.* 2. *a*). The fruit consists of a pair of kidney-shaped achænia, or nuts, bristly all over with stiff hooks, separated at the base by the hardened and widened axis, and curving inwards

till their points nearly meet (*fig.* 4.). In the inside of each nut is a curved seed, containing a small embryo of the same figure, embedded in hard horny albumen, and turning its radicle towards the base (*fig.* 5.).

You cannot have a better example than this of the great importance of botanical knowledge, in forming a correct opinion upon many common questions. A person, unacquainted with the science, would not comprehend the possibility of this Goosegrass being allied to the Honeysuckle (Vol. I. *Plate* XIV.), and yet I shall shew you, by the plainest evidence, that such is an indisputable fact.

Gather a specimen of any common Honeysuckle, and compare it with another of the Snowberry, which Linnæus used to consider a sort of Honeysuckle; then place by the side of the Snowberry a Laurustinus in flower, and by the Laurustinus a bunch of Elder blossoms. You will then find, although the Honeysuckle and the Elder at first seemed very dissimilar, yet that the two may be gradually connected by so few as these two transitions.

Next, compare the Goosegrass with the Elder. The former has a small, white, regular, monopetalous corolla, with as many stamens as lobes, an inferior ovary, containing one seed in each cell, seeds with an embryo buried in horny albumen, and opposite leaves without stipules; in all these important points the Elder coincides. That plant, indeed, is a small tree, with pinnated leaves, large cymes of flowers, three cells to the ovary, and succulent fruit, while Goosegrass is a prostrate, annual, rough-stemmed plant, with simple

whorled leaves, solitary flowers, two cells to the ovary, and dry bur-like fruit. But such matters are irrelevant to the discussion; for as there is no question as to the great difference of these two plants, the point to determine is, whether they are related to each other, and, if so, in what degree. It is impossible to deny that the points of coincidence which I have named to you, are sufficient to establish the fact of their relationship; and, therefore, as it is proved that the Goosegrass is related to the Elder, and the Elder to the Honeysuckle, it follows that the Goosegrass and the Honeysuckle are also related to each other; but not equally. The Elder and the Honeysuckle are plants of the same natural Order (or Tribe, as it has pleased us to call natural Orders in this correspondence), and may therefore be said to be related to each other in the first degree; Goosegrass, on the contrary, belongs to a distinct natural Order, and therefore cannot be related in more than the second degree.

Goosegrass may, in fact, be taken as the type of the MADDER TRIBE, the peculiar distinctions of which are drawn from the angular tems, whorled leaves, and double one-seeded ovary. *Madder* itself (Rubia tinctorum), from the roots of which a valuable dye is extracted, is very much like a Galium, but is more vigorous in its mode of growth, has larger hooks, and a succulent fruit; in which latter respect a greater approach is made to the Elder than in the case of Bedstraw.

In the wild places of this country, plants of the Madder Tribe abound. The Galiums, of which there

are many species, occur on banks, heaths, and even walls, and are among the most common of plants. One of them, Galium verum, with loose bunches of pretty yellow flowers, is, in some counties, called *Cheese-rennet*, because of its having been formerly employed to curdle milk. *Woodruff*, a native rival in fragrance to the Heliotrope, is the Asperula odorata; it is found occasionally in woods, and is known by the long tube to its corolla, and the four small deciduous teeth of its calyx; otherwise it is very nearly a Galium. *Field Madder* (Sherardia arvensis) has a little purple blossom, and its fruit is terminated by the four permanent teeth of its calyx; it is a common annual in dry fields.

I need not ask if you have forgotten Compound flowers (Vol. I. *p.* 199. *Plate* XVII. I?), for they are of such common occurrence, that to have had them once pointed out is to know them for ever. But I may ask if you recollect exactly what their structure is, because there are plants very like them at first sight, and which you must know how to distinguish. For example, Astrantia, which is one of the Umbelliferous Tribe, and Gilia, belonging to the Greek Valerians, have their flowers in heads, and might be taken for Compound flowers by an incautious observer. They are not, however, so likely to deceive you as the plants of the SCABIOUS TRIBE to which I have once already casually referred (Vol. I. *p.* 208.), and of which it is now time to speak more particularly.

Purple, or *Sweet Scabious* (Scabiosa atropurpurea),

is one of the most beautiful of our annual exotics, with its intensely deep purple corollas, and *Starry Scabious* (S. stellata), although not very pretty when in flower, is often found in gardens, where it is cultivated for the sake of its curious heads of seed-vessels, terminated by dry starry cups. In this country, the meadows, pastures, and corn-fields, are often enamelled by one or two native species, of which we will select what is commonly called the *Devil's-bit Scabious* (Scabiosa succisa, *Plate* XLIV. 2.); a strange name, which originated in a popular belief, in former days, that his Satanic majesty bites off the ends of its roots; in proof of the truth of which, their black colour and abruptly-broken extremities are safely appealed to.

The root-leaves of this plant are obovate and undivided, those of the stem are coarsely toothed, while the uppermost are narrow, sharp-pointed at each end, and quite destitute of toothing. The flowers are a bright clear blue, and collected into round balls, at the top of long, slender, bristly peduncles (*fig.* 1.); in general appearance they very much resemble those of a compound flower, only they have not a distinct involucre; in the exact details of structure there are, however, several important differences, as you will see. To understand the matter fully, take one single floweret away from the others, and study it by itself; the remainder are like it. In the first place, you will remark that it is subtended by a narrow sharp-pointed bract (*fig.* 2. *a.*), fringed with long delicate hairs. It appears to have a double calyx; the exterior being an inferior, pale, greenish-white cup (*fig.* 2. *b.*), with five

angles and five shallow teeth; the interior (*fig.*2. *c.* and *fig.* 4.) being a superior greenish disk, expanded into five purple hairy horns; of these two coverings the first is a little involucre, of the same nature as that in the Mallow (*Plate* VI. 1. *fig* 3. *a.*), the second is the true calyx. The corolla is funnel-shaped, with its border divided into four nearly equal lobes (*fig.* 2.); there are four stamens, which spread away from each other, without at all adhering (*fig.* 3.) either by the filaments or anthers. The ovary is one-celled, and what we technically call inferior; but it is a most unusual and instructive illustration of the correctness of the opinions of modern Botanists as to the real nature of a superior calyx (Vol. I. *p.* 28.). In the plant before us the ovary is a thin membranous case (*fig.* 5. *b.*), surrounded by the sides of the calyx, which however, does not adhere to it, except quite at the orifice of its tube; but there the union is so complete that no trace of the separation lower down can be seen, except upon dissection. The style is a slender thread, curved upwards, and bearing a purple, narrow, hammer-headed stigma (*fig.* 4. *a.*). The ovule hangs pendulous from the top of the ovary (*fig.* 5. *a.*). The ripe seed-vessel is an oval seed-like body, terminated by five stiff, brown, hairy horns, and containing a pendulous seed, the embryo of which lies in albumen, with its radicle pointing to the apex of the seed-vessel (*fig.* 7.).

These details shew you that, notwithstanding the general resemblance of the Devil's-bit to a composite flower, it differs in having distinct stamens, and a pendulous seed, exclusively of all other circumstances.

This is, in reality, the difference between the *Tribe* of *Composite Flowers*, and the *Scabious* Tribe.

The most remarkable plant of this natural Order is the *Teasel* (Dipsacus Fullonum), the bracts of which are hard and sharp, and project beyond the flowerets, rendering the flower-head a cone of formidable spines. These heads are used in vast numbers in the carding of woollen cloths, and are found superior for that purpose to any artificial substitute yet invented.

EXPLANATION OF PLATE XLIV.

I. The Madder Tribe.—*Cleavers, Goose-grass,* or *Whiptongue* (Galium Aparine).—1. A magnified flower.—2. A section of the same; *a* the green epigynous disk.—3. A stamen.—4. The ripe fruit—5. A section of one half of a ripe fruit, shewing the embryo lying in the hard horny albumen.—6. An embryo separated, and inverted.

II. The Scabious Tribe.—1. The *Devil's-bit Scabious* (Scabiosa succisa).—2. A floweret with the bract *a*, and the small involucre or involucel *b*, beyond which the calyx *c* is seen projecting.—3. A corolla cut open.—4. A pistil with the superior calyx; *a* the stigma.—5. A vertical section of the calyx, shewing that the ovary *b* does not adhere to its sides, except at the point; *a* the ovule.—6. The anther and upper part of a filament.—7. A section of a ripe fruit, surmounted by the calyx, and shewing the pendulous embryo lying in the midst of albumen.

The Jasmine Tribe. XLV. 1.

White Jasmine.

The Asclepias Tribe. XLV. 2.

Pink Asclepias.

LETTER XLIV.

THE JASMINE TRIBE—THE ASCLEPIAS TRIBE.

Plate XLV.

I FORMERLY said something to you concerning the difference between the *Olive* and the *Jasmine* Tribes (Vol. I. *p.* 168.); and perhaps the brief remarks then made upon the method of distinguishing them may have satisfied you. Nevertheless, let us not pass the Jasmine by with inattention, for surely so lovely a plant deserves something more than a careless glance of recognition.

The *White Jasmine* (Jasminum officinale), the pride of the cottager, and the envy of the citizen, within whose smoky streets no art can make it flourish, is a native of the mountains of India, whence years ago it found its way to the Persians and Arabs, who called it Yasmeen, and thence passed to Europe. Its leaves offer a good example of what we call *unequally pinnated,* or *pinnated with an odd one;* that is to say, they consist of several pairs of leaflets (*Plate* XLV. 1.), with an odd leaflet at the end. The leaves are opposite each other on the stem, and have no stipules. The virgin-white odoriferous flowers grow in little sessile clusters, or umbels, at the end of short branchlets. The calyx is inferior (*fig.* 3.), divided into five narrow awl-shaped segments, and covered externally with glandular down. The

corolla is salver-shaped, with a long yellowish tube, and a border divided into five sharp-pointed lobes, which do not fit to each other by their very edges as in the Olive Tribe, but overlie each other, and are twisted together in the bud state (*fig.* 1. *a.*); or, in fewer words, the æstivation is imbricate, and not valvate.

There are only two stamens, arising from near the middle of the tube of the corolla (*fig.* 2.). This is a degree of irregularity much beyond that of the Olive Tribe, which has only four segments of the corolla, and is more analogous to what occurs in the Foxglove and neighbouring Tribes. In many species of Jasmine it is carried further still; for the corolla has sometimes six, seven, eight, or even twelve divisions, and it must therefore be considered to have a tendency to form two or even three rows of petals; or else to develope a part of its stamens in the form of petals, and even to produce a second row of true petals in addition. Thus the scheme of organization in common Jasmine will be—

S S S S S
P P P P P
. . s s .

in a Jasmine with seven segments to its corolla—

S S S S S
P P P P P
. s s s s

and with twelve segments—

S S S S S
P P P P P
P P P P P
s s s s .

so that those species only can be considered complete, in the number of their parts, whose corollas consist of eight or thirteen segments.

The ovary of the Jasmine (*fig.* 3.) is superior, and contains two cells, with an ascending ovule in each; another mark of distinction from the Olive Tribe, in which the ovules are pendulous (*Plate* XIII. 2. *fig.* 5.). The style is erect and slender; the stigma a fleshy, glandular, two-lobed club. The fruit (*Plate* XLV. 1. *fig.* 4.) is a black oblong berry, containing one perfect and one abortive seed (*fig.* 5.); the embryo is covered over by the seed-coat without the aid of any albumen.

Such is the common sweet white Jasmine, and such, in all essential points, is the remainder of this fragrant genus. The species differ in respect, 1. to the manner of growth, some climbing, and others forming mere bushes; 2. to their leaves, some of which are undivided, and their form various in various species; 3. to the colour of their flowers, which, although usually pure white, is sometimes yellow; and 4. to their corolla, the number of whose divisions is, as has lately been mentioned, extremely variable. All of them, however, have monopetalous corollas, with several *imbricated* segments, only *two* stamens, and a superior, succulent fruit, with one or two erect seeds.

The Jasmine Tribe consists of few plants besides Jasmines themselves. The most remarkable is the *Tree of Mourning* (Nyctanthes Arbor Tristis), or *Hursinghar*, an Indian tree of small size, whose "exquisitely fragrant flowers, partaking of the smell of

fresh honey" (I quote Dr. Roxburgh's words), open at the close of day, and fall off before sunrise, strewing the ground with their remains, and furnishing to the Indian girls the materials with which they decorate their hair. After the flowers have passed away, this tree becomes ragged and shabby, assuming a melancholy appearance, as if in grief for the loss of the fragrant treasures that it once dispensed with so lavish a hand. This circumstance, and the dark hours of night which the plant selects for displaying its charms, have doubtless given it the name of Arbor tristis, or the tree of mourning. It is known botanically from a Jasmine, by its fruit being a dry seed-vessel, instead of a succulent berry.

You may well be puzzled with the plant enclosed in your letter of yesterday; and you are right in your conjecture that it is not even alluded to, in any part of our previous correspondence. It is the *Pink Asclepias* (Asclepias incarnata), and forms the type of the Natural Order of that name. Its flowers are most curiously constructed, and may well embarrass you even to name the parts of which they consist. After you have received this letter, gather a fresh cluster of the blossoms, and follow me in the ensuing description.

In gathering it, you will find milk flow abundantly from the wound; in this plant the milk is white, but in one species inhabiting the woods of Sierra Leone, it is of the colour of blood. If that plant had but grown in Palestine, it might be supposed to represent

the enchanted tree, which so surprised Tancred in the sorcerer's wood.

> "When, dreadful to his view!
> The wounded bark a sanguine current shed,
> And stain'd the grassy turf with streaming red."

This milky blood, whether white, red, or any other colour, abounds in the substance called Caoutchouc or Indian Rubber, a large proportion of which is actually procured from plants botanically related to the Asclepias.

You will readily distinguish the calyx, which consists of six, narrow, hairy sepals, spreading back from the corolla (*Plate* XLV. 2. *fig.* 5. *a.*). Their purple colour betrays the petals (*fig.* 2. *a.*), which spread widely away from the centre, adhering at the base only, into a short tube, and therefore constituting a monopetalous corolla. From the middle of the tube there rises a pentagonial column (*fig.* 2. *b.*), forming the base of five other concave petals (*fig.* 2. *c.*), which stand erect, and collect into a sort of pink coronet (*corona*) to the flower; from the inside of each of these coronet-petals, springs a firm, solid horn, curving forwards towards the centre (*fig.* 3. & 4.). The monopetalous corolla is therefore composed of two whorls of petals, of which the outer are flat and spreading, the inner concave, erect, and horned internally.

Cut away the true petals and those of the coronet; you will find that the pentagonal column consists of five purple-green anthers (*fig.* 5. *c.*), having no filaments, where

they come in contact projecting into five whitish angles, adhering firmly by their faces to a pentagonal, flattish, fleshy, red and green table, which they surround (*fig.* 7. *a.*), and having each a whitish, membranous termination, which curves over the table aforesaid (*fig.* 5. *e.*). In the next place, carefully remove two of the anthers, turning them on their backs (*fig.* 6.); you will find that each is two-celled, and that the pollen of the contiguous cells of two different anthers, forms two orange-coloured bags (*fig.* 6. *a.* and *fig.* 9.), which are very loose in their cells, and adhere to a blackish, oval gland, that belongs to the angle of the table aforesaid (*fig.* 7. *b.* 6. *b.* & 9. *b*); so that when you open the anthers, you see the bags dangling from the gland like a pair of yellow pouches (*fig.* 9.).

After all this apparatus is removed (as at *fig.* 7.), you have a view of the pistil, consisting of two ovaries placed in close contact, and each containing a large, fleshy placenta, covered with ovules (*fig.* 8.). To each ovary is a single style, which is placed parallel and in contact with that of its neighbour, without uniting to it (*fig.* 7. *c.*). The styles are held together by the fleshy five-cornered table that surmounts them (*fig.* 7. *a.*), and which stands in the place of a stigma, without exactly being one; for the influence of the pollen is not communicated to the ovules through its tissue, as in true stigmas, but somewhere about the point where the stole and the table join (*fig.* 7. *d.*).

When the corolla and stamens have fallen off, the table and styles give way, the two ovaries diverge, and if both of them continue to grow, you will find, when

the seed-vessel is ripe, that it consists of two, dry, tough cases, opening by the face, and placed almost at right angles with each other, so that the seed-vessels and stalk together, form the figure T. But it often happens that one ovary shrivels up and disappears; in that case, the other grows upright upon its stalk (*fig.* 10.), as is usual in other plants. In the inside of the seed-vessel is a large number of flat, brown seeds, terminated by a delicate silk tuft (*fig.* 10.), and containing a thin, flat embryo, without any albumen (*fig.* 11.).

It must be quite plain to you, that at least three circumstances will separately characterise the Asclepias Tribe; for no other Monopetalous order has either, 1. the pollen adhering into bags, or, 2. the anthers adhering firmly to a stigma-like table, or 3. the corolla augmented by a coronet, or second row of petals.

You must not, however, expect that all the tribe will agree in the nature of their coronet; some have only a single row of secondary petals, as the plant now before you, others have two or even three rows, in various states of combination or developement. For the purpose of studying these matters, you should examine the curious speckled flowers of the *Stapelia*, and the honey-dropping, waxen blossoms of the *Hoya*. The former, indeed, will generally repel you by their intolerable smell, if you wait till they are naturally expanded; but if you cut them open some days previously, you can examine them without inconvenience.

Cynanchum and *Periploca*, are other common genera

of the same tribe, which you will easily procure for study.

Very nearly allied to the Asclepias Tribe, are the poisonous *Apocynums*, represented in the gardens by the *Periwinkle* (Vinca), the *Oleander* (Nerium), and the Apocynum itself. They agree with the Asclepias Tribe in their milky juice, and their appearance, but differ in having the stamens free from each other and from the stigma, the pollen in its usual state, instead of being collected into bags, and in the want of any coronet of secondary petals, except now and then a single row of scales, growing in the mouth of the tube of the corolla.

As the plants of the Apocynum Tribe, with the exception of those now mentioned, are not likely to fall in your way, it is not necessary for you to be detained with any account of them.

EXPLANATION OF PLATE XLV.

I. The Jasmine Tribe.—1. *Common white Jasmine* (Jasminum officinale), *a*, a flower-bud, shewing the imbricated twisted æstivation —2. A corolla magnified, and opened to shew the position of the stamens.—3. A section of the calyx and ovary, exhibiting the position of the ovules.—4. A ripe fruit.—5. The same cut across.

II. The Asclepias Tribe.—1. The *Pink Asclepias* (Asclepias incarnata).—2. A flower magnified; *a a* petals, *b* the column that supports the coronet of secondary petals, *c c*.—3. One of the petals of the coronet cut off the column.—4. A section of the same, to shew the origin of the horn.—5. A flower from which all the petals have been removed; *a a* sepals, *b* the column of the coronet, *c c* anthers, *d d* the projecting angles formed by the sides of the anthers, *e* the membranous appendages at the tip of the anthers, *f* the glands to

which the pollen-masses adhere.—6. Two anthers turned on their backs; *a a* a pair of pollen-masses, *b* the glands to which they adhere. —7. A pistil; *a* the stigma-like, pentagonal, fleshy table, to which the anthers adhere, *b b* the places where the pollen-glands adhere, *c* the parallel styles, *d* the place through which fertilization is conveyed from the pollen to the ovules.—8. A transverse section of the two ovaries.—9. A pair of pollen-masses, adhering to the gland *b*.— 10. Ripe seed-vessels.—11. A seed cut across, to shew the embryo. —12. A perfect seed, with the feathery tuft that terminates it.

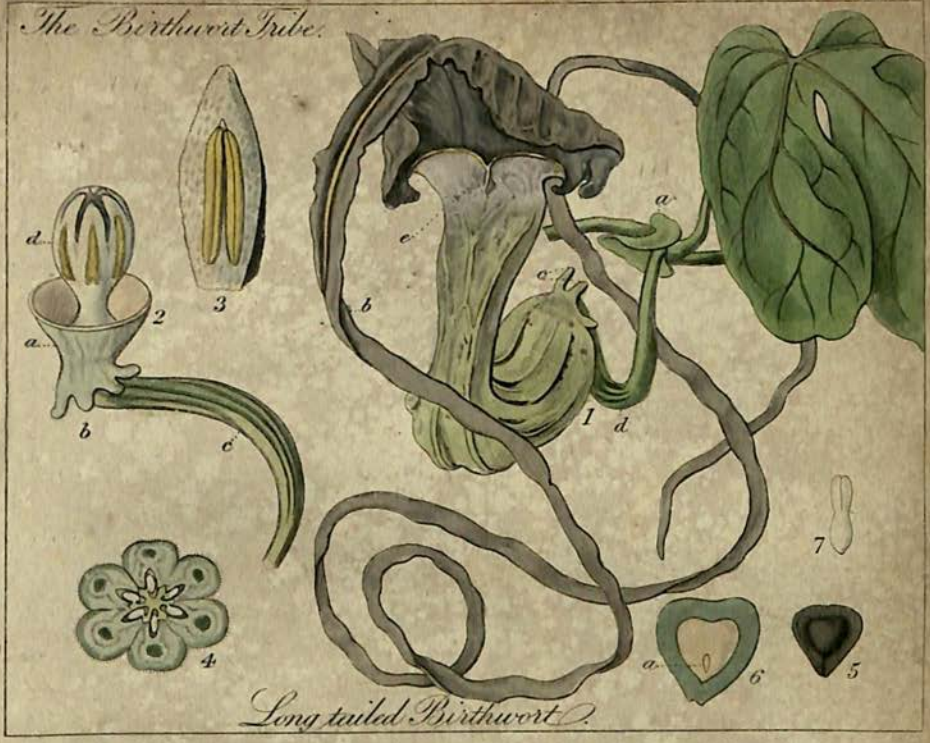
LETTER XLV.

THE BIRTHWORT TRIBE—THE ARUM TRIBE.

(*Plate XLVI.*)

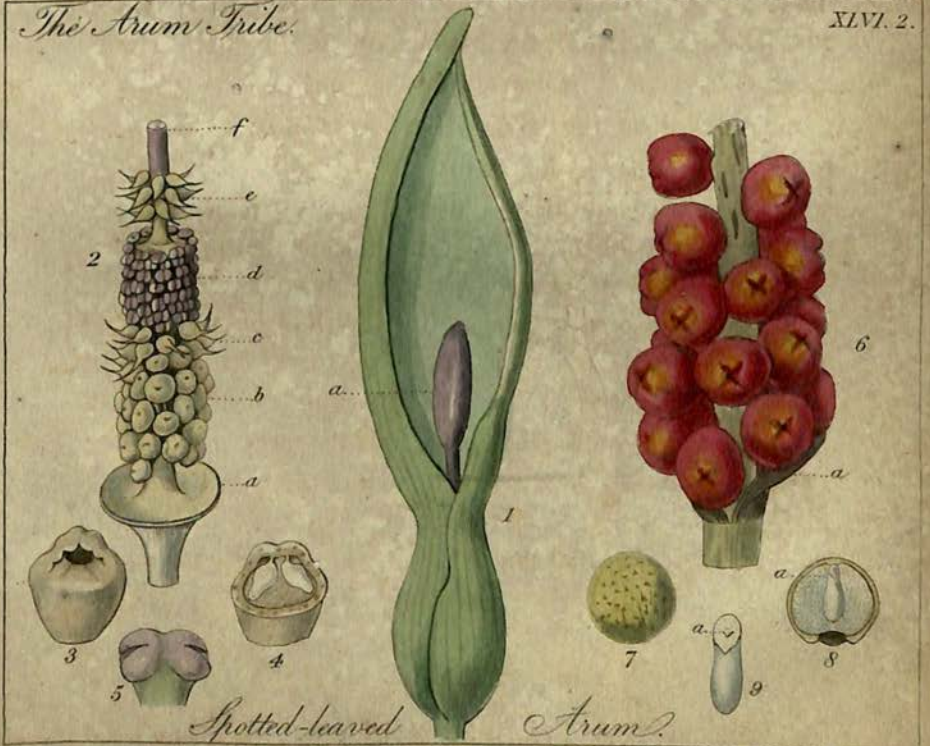
Did you ever remark a broad, round-leaved, twining plant, near the entrance to the flower garden, on the right hand, next the little rock-work for Sedums, with dingy, brownish, lead-coloured flowers, bent almost double in the middle, and only to be discovered by a careful search among the leaves? It is a plant called Aristolochia Sipho, or, in English, the *Siphon-flowered Birthwort*, and belongs to the same natural order as the *Wild American Ginger* (Asarum canadense), that little, round-leaved, stemless plant, which forms two or three clusters among the Azaleas, in front of the library window, and whose cup-shaped brown flowers I remember shewing you, as carefully hidden among the leaves as if they had been, what they really look like, the nests of some fairy bird. These plants are all of them excessively curious, because of the strange form of their flowers; most of which are singularly mottled or veined with brown or purple, and some of which are quite gigantic in their dimensions. Humboldt saw the children of an Indian village, wearing the helmet-shaped flowers of one

The Birthwort Tribe.



Long tailed Birthwort.

The Arum Tribe.



Spotted-leaved Arum.

species, instead of hats, and Brazilian kinds have been discovered of scarcely a smaller size.

These plants are brought to my recollection, by a quantity of blossoms of Aristolochia trilobata, the *long-tailed Birthwort*, that some unknown friend has just sent me from her hothouse. With this letter you will receive a portion of them, which we will proceed to examine systematically (*Plate* XLVI. 1.). We will take no notice of its twining stem, nor of its leaves, for these organs vary so much in different species, as to form no part of the distinctive characters of the order, but we will confine ourselves to the fructification.

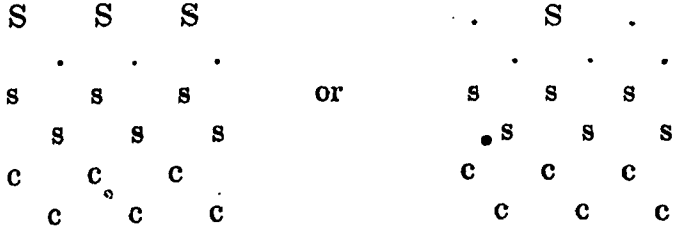
The flower is a long tubular calyx, strongly veined and ribbed, curved back in the middle, so much as almost to be bent double, pale, livid, brownish-yellow externally, and deep chocolate brown in the inside, and at the upper end (*fig.* 1.). At the lower end it is inflated; and at the very base it is extended into six little horns or spurs (*fig.* 1. *c.* & *fig.* 2. *b.*). At the upper end it is very much dilated and puckered; on one side (*fig.* 1. *e.*) it is deeply notched; on the opposite side it is extended into a flat, twisted strap, thirteen or fourteen inches long, which, when the flowers are on their branches, hangs down like the tail of some animal; one might even fancy it belonged to a mouse, whose body was secreted in the cup of the flower. This curious calyx is quite at variance with any thing, however irregular in structure it may be, that we meet with in the same part, in the rest of the vegetable kingdom. Botanists seemed generally

agreed in considering it composed of three consolidated sepals, of which two are rounded and one only produced into a long appendage or tail. This opinion is founded partly upon the prevalence of the number three in the other organs of fructification, partly upon the regular flowered genera of the Birthwort Tribe having a calyx of three divisions, and in some measure upon the theory, that a calyx is in all cases to be considered a whorl of sepals. It may, however, be fairly doubted whether in the genus Aristolochia, the calyx is really formed of more than a single sepal, or leaf, rolled together into a tube, and, in the present species, extended at its point into a tail. But to this I shall advert again.

At the bottom of the cup of the calyx stands a short, club-shaped column (*fig.* 2.), split into six lobes at its point; and consisting of six anthers, adhering to a style and six-rayed stigma which they conceal. Each anther (*fig.* 3.) is a fleshy, somewhat shrivelled, sharp-pointed connective, on the outside of which are planted two parallel cells, which consequently are turned away from the stigma, and face the inside of the calyx. The ovary is placed beneath the calyx, in the form of a club-shaped, twisted stalk (*fig.* 1. *d.*); it contains six cells (*fig.* 4.), in each of which is a long row of ovules, attached obliquely to the placenta. With the seed-vessel of this species I am unacquainted; but in others it is a large pear-shaped capsule, opening by six sutures at the sides, and allowing the seeds to escape through a sort of coarse grating, produced by a laceration of the dissepiments. The seeds are

thin, flat, and dark brown (*fig.* 5.), and contain a small, dicotyledonous embryo, at the base of hard, horny albumen (*fig.* 6. & 7.).

Asarum, the only other genus of this order you are likely to meet with, has a regular three-lobed calyx, and its stamens are distinct from each other; the adhesion of the stamens into a central column, does not therefore form any part of the essentials of the Birthwort Tribe, which is characterised by its inferior, six-celled fruit, its six stamens, and by its tubular calyx without corolla, divided into either one or three lobes; so that the type of its structure is essentially ternary, or thus,



which among Dicotyledons is very uncommon.

It is, as you know, chiefly in Monocotyledons or Endogens, that the number three prevails in the parts of fructification, and it is not a little curious, that the stem of Aristolochias should be almost intermediate in structure between that of Exogens and Endogens. It has the medullary processes of the former, and consequently their pith; but it wants the concentric layers in the wood, which is formed of bundles of woody matter, collected indeed into wedges, but plunged down into a pithy substance, as in Endogens. The Birthwort Tribe may therefore be considered one of

several cases, where the structure peculiar to one class assimilates itself to that of the other.

A case of this sort, where Aristolochias themselves may be considered as typified among Endogens, occurs in the ARUM TRIBE (*Plate* XLVI. 2.). You probably know this tribe already, from the common *spotted Arum* (A. maculatum) of our hedges, or the *speckled Dragon Arum* (A. Dracunculus) of the gardens. These two species, at least, are so very common, that if you do not yet know them, you can have no difficulty in procuring them for examination.

The *Arum Tribe* consists of stemless or long-stemmed plants, whose internal structure is strictly that of Endogens, but whose leaves bear more resemblance to those of Exogens; it is, however, to be observed, that the lobed figure of the leaves, and their branched veining, to which the resemblance is due, need not be confounded with the netted veining of Exogens, because in Arum, the veins are branched rather than netted, and are in a great measure destitute of the lateral, minute branchlets, to which the peculiar appearance of Exogenous leaves is chiefly owing. Many of these have large, tuberous, under-ground stems, which, although acrid, and even poisonous when raw, nevertheless, by slicing, washing, and cooking, become fit for food, and are actually so employed, in England only in a few places, or in times of scarcity, but in tropical countries, as a common, every-day, esculent vegetable. Their foliage is generally more or less lobed, and sometimes very curiously, but is so much

diversified, that it can hardly be said to offer any certain mark of recognition. The great and striking feature of the natural order resides in the *spathe* and *spadix*. As these terms are new to you, they must be explained before we proceed further.

A *spathe* is a leaf, usually coloured, but sometimes green, which is rolled up round a spike of flowers; it is, in fact, a sort of large bract.

A *spadix* is a fleshy spike, covered all over with flowers, and enclosed in a spathe.

In all Araceous plants, the flowers are collected upon a spadix, and are enclosed in a spathe. Both these parts, in particular species, have most extraordinary appearances. The spathe, for example, is sometimes a foot and more in diameter, forming a huge vegetable bell, of which the spadix would be the clapper, if the spathe were not erect; it is often stained with the deepest and richest colours; and in some cases it is extended on one side into a long slender tail, very much like that of the calyx in the long-tailed Birthwort. The spadix, on the other hand, is either covered all over with flowers, in which case it makes no unusual appearance, or it is naked at the point, and then assumes the strangest shapes, which sometimes, moreover, glow with all the colours of the spathe. Thus in the Dragon-Arum it is a long purple horn, standing up, and projecting from a large, deep-purple spathe; in others it hangs down from the spathe like a slender tail; and in some cases it is enlarged into a disgusting, fungus-like, livid, excrescence.

The *common spotted Arum* (Arum maculatum), will give you a sufficiently correct idea of the structure of the Arum Tribe. It has a smooth, erect, oblong spathe (*fig.* 1.), green outside, whitish inside, and unrolling to expose the point of the spadix (*fig.* 1. *a.*), which children call the lady riding in her coach. If you extract the spadix, you will find it a long, soft, fleshy branch, the upper part of which is quite naked, and the lower part covered with naked flowers. At the bottom (*fig.* 2. *b.*) stand several tiers of round ovaries; above them are placed two or three rows of abortive ovaries, in the form of horned, pear-shaped bodies (*fig.* 2. *c.*); then appears a crowd of stamens (*fig.* 2. *d.*); and above those is again collected a small cluster of abortive ovaries (*fig.* 2. *e.*). The ovaries are so many naked fertile flowers, the stamens are each a naked sterile flower; and the inflorescence is, in strict technical language, a crowded monœcious spike, wrapped up in a large leafy bract.

The ovary is puckered and hollowed out at the apex, for a stigma (*fig.* 3.), and contains two ovules growing from the side of a single cell (*fig.* 4.). The stamen has a short thick filament, with two round lobes, placed obliquely on its end, for an anther (*fig.* 5.).

The fruit ripens in the form of a spike of orange-coloured, roundish berries (*fig.* 6.), each of which contains a single seed (*fig.* 7.), enclosing a monocotyledonous embryo (*fig.* 8.), surrounded by farinaceous albumen. On one side of the embryo is a narrow slit (*fig.* 8. *a.*), at the bottom of which lies the minute

point (*fig.* 9. *a.*), or plumule, which eventually becomes the new stem.

Such is the structure of the spotted Arum. The other genera differ in the spadix being altogether covered with flowers, or in the absence of abortive ovaries, or in the internal structure of the anther and ovary, or even in that of the style and stigma; but the spathaceous inflorescence distinctly marks the order in all cases.

EXPLANATION OF PLATE XLVI.

I. The Birthwort Tribe.—1. Leaf and flower of the *long-tailed Birthwort* (Aristolochia trilobata), natural size; *a* the stipules; *b* the strap-shaped tail of the calyx; *c* the horns at the base of the calyx; *d* the ovary; *e* the notch on one side of the border of the calyx.—2. The column of stamens *d*, seated in the base of the calyx *a*; *b* the horns of the calyx; *c* the ovary.—3. An anther separated from the other five.—4. A transverse section of the ovary.—5. A seed of another species of Birthwort, natural size.—6. The same magnified, with half the skin cut off, to shew the embryo *a*, lying in horny albumen.—7. The embryo.

II. The Arum Tribe. 1. Spathe of *Spotted Arum* (Arum maculatum), natural size, with the point of the Spadix at *a*.—2. A spadix taken out of the spathe; *a* the base of the spathe; *b* ovaries; *c* abortive ovaries; *d* stamens; *e* abortive ovaries; *f* part of the stalk of the naked head of the spadix.—3. An ovary.—4. A transverse section of the same —5. A stamen.—6. The spadix covered with ripe fruit; *a* the withered remains of the spathe.—7. A ripe seed.—8. A longitudinal section of the same, shewing the embryo lying in albumen; *a* the slit communicating with the plumule.—9. The monocotyledonous embryo, with a portion of its root-end sliced away, and shewing the conical plumule *a*.

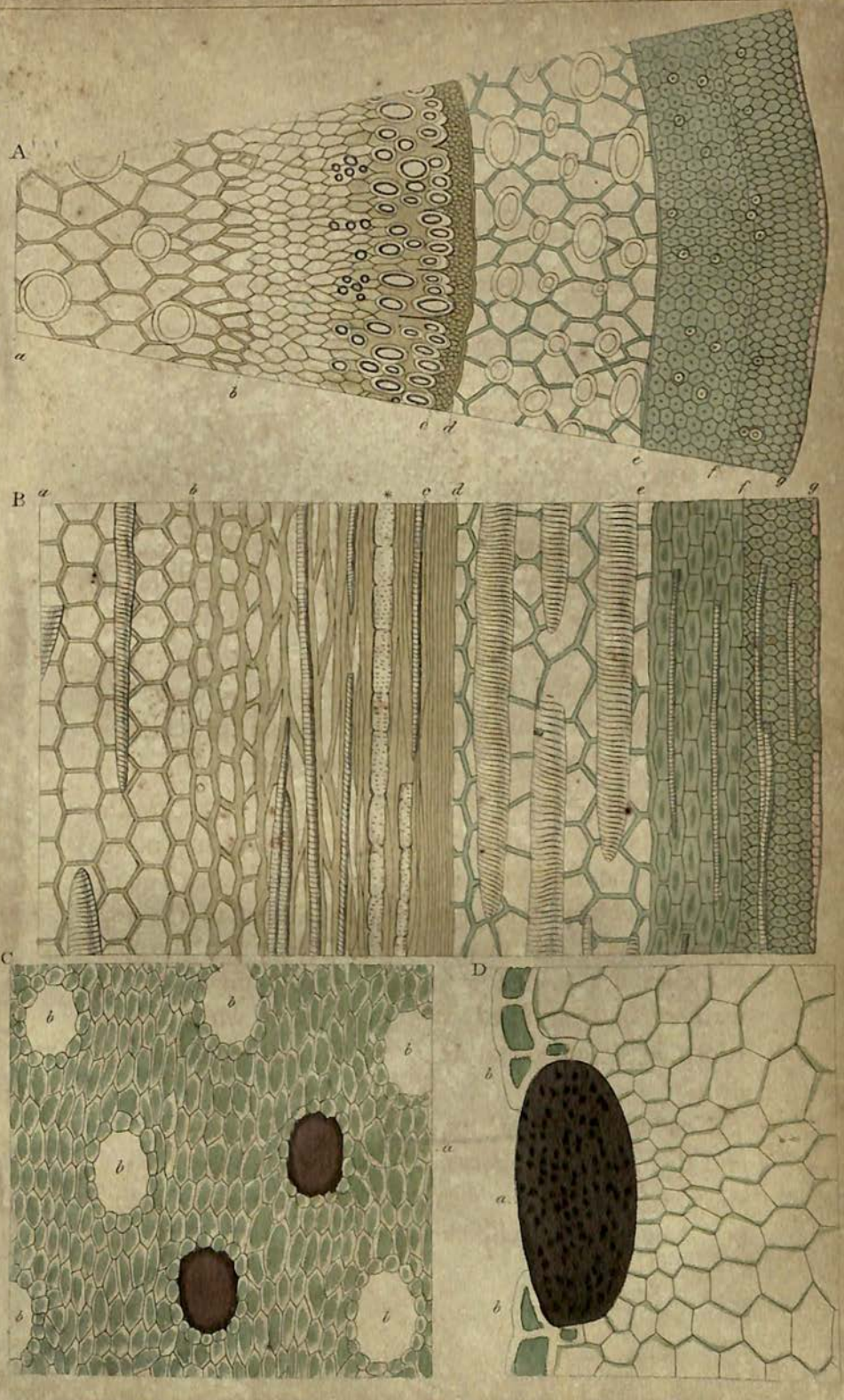
LETTER XLVI.

PITCHER PLANTS—VEGETABLE ANATOMY.

(*Plates XLVII & XLVIII.*)

I MUST not dismiss the Birthwort Tribe without adverting to those curious vegetables called *Pitcher-plants,* in the East Indies, and to the *Monkey-cups* they bear. The production of hollow bags instead of leaves, is not a very uncommon occurrence in plants; in *Dionæa* a preparation is made for their formation by the dilatation of the leaf-stalk; in *Side-saddle flowers* (Sarracenias), the edges of the petiole are rolled up and united into a cup, over which the end of the leaf curves, as if to cover it; in some plants the bracts are changed into bags which hang down amongst the flowers; and in an East Indian plant called Dischidia Rafflesiana, which climbs to the top of the highest trees in the forests of Penang, the upper branches are loaded with clusters of tough, fleshy, leathery bottles, filled with water, into which roots, protruded from the branches, dip their points to drink.

Not only is *Sarracenia* found in our gardens now and then, and *Cephalotus,* a New Holland plant, whose singular pitchers are beautifully fringed and veined; but Nepenthes itself, the true *Pitcher-plant* of the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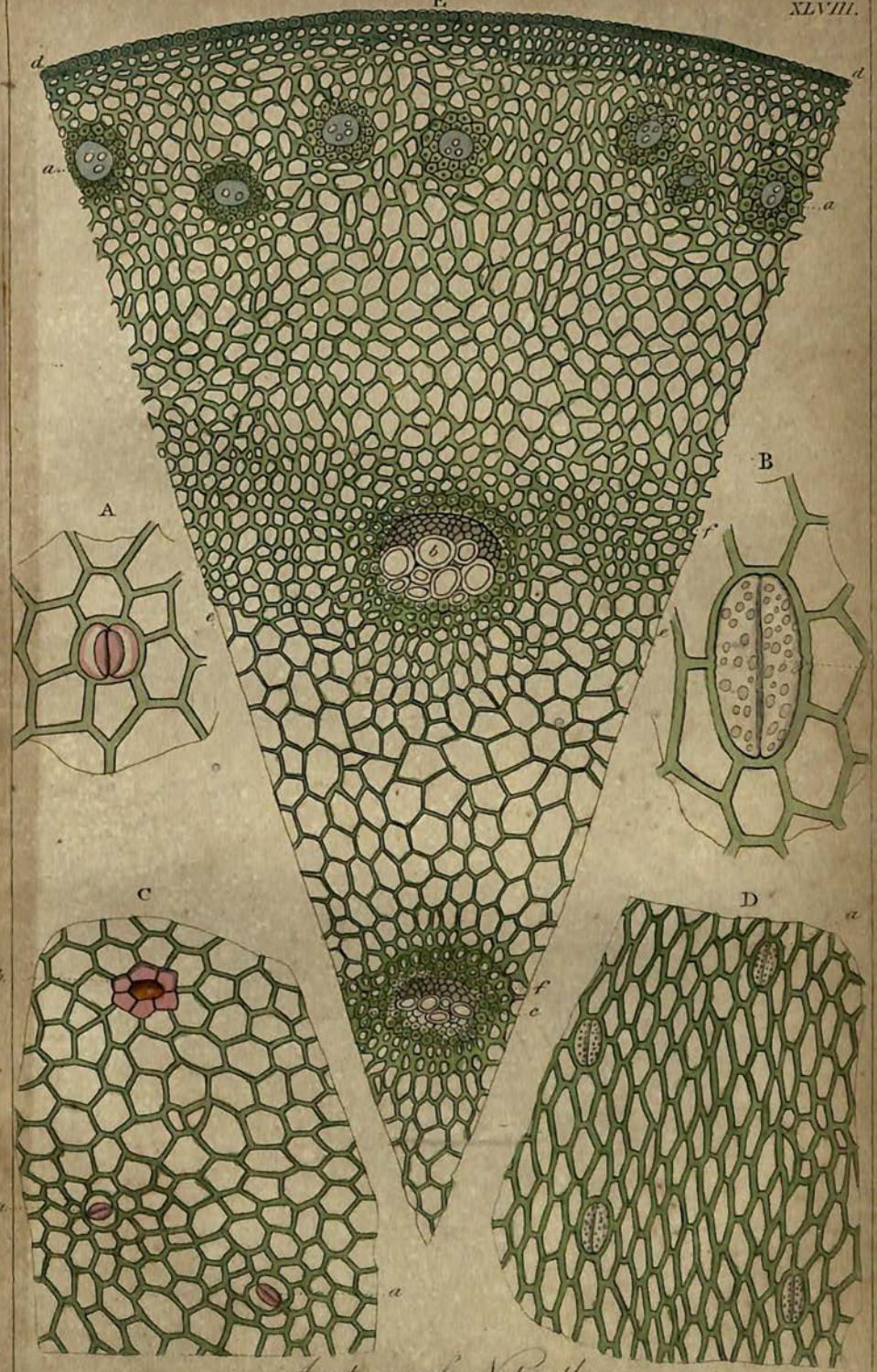


Anatomy of Nepenthes.

East Indies, is successfully cultivated in several places. A large branch which I have received from Wentworth, through the kindness of Lord Fitzwilliam, gives me an opportunity of describing it to you in detail; and I know no plant that better deserves to be understood.

The stem of Nepenthes distillatoria, the only species as yet in the possession of cultivators, forms a slender woody stem, growing ten or twelve feet high, or probably much longer, and supporting itself upon surrounding plants, by means of its numerous tendrils. In its native country it inhabits swampy situations, and consequently, in a hothouse, it must be treated accordingly. At the lower part of the stem there appear a few leaves of a bright green colour, a little curved back at the point, where they are rounded off, tapering to the base and half embracing the stem; these leaves vary in length from one to four or five inches, and have nothing in their appearance to distinguish them from ordinary leaves. But higher up the stem, the leaves grow much longer, and taper into a tendril at the point, from which is suspended a long funnel-shaped, green cup, often as large as a three ounce vial, covered by a lid, and sometimes containing water. At first it is entirely closed up by the lid, but after a time the latter separates, except by its hinge, and merely overhangs the mouth of the cup, which is bordered by an exquisitely beautiful, stiff, crimped, frill, which curves inwards, and forms a broad ledge on which the sides of the lid may rest. In all cases the pitchers contain fluid at some time or other; but

after they are once opened it usually dries up; so that the tales which are current about their being sought by wild animals, especially monkeys, for the water they contain, must be received with some suspicion. The use of the water is altogether unknown, nor indeed are Botanists generally aware by what apparatus it is secreted. There is, however, a peculiar glandular structure in the inside of the pitchers, which is the more probably connected with the secretion, as it is not found on any other part of the Nepenthes, nor, so far as I know, in any other plants.

If you observe attentively the inside of the lid of the common garden species, or peep down into the pitchers, you will find the surface distinctly marked by inequalities, which give it somewhat the appearance of shagreen. Placed under a microscope, the inequalities prove to be caused by the presence of an infinite number of oval, dark brown glands (*Plate* XLVII. *fig. C. a.*), lying in the midst of the fine, compact, cellular substance of the cuticle. The cells of the latter are tolerably regular, lozenge-shaped hexagons, except at the edges of the glands, where they become perceptibly smaller and rounder (*fig. C. b.*); and, what is very remarkable, the cuticle, instead of spreading over the glands, leaves them quite naked, so that, when it is stripped off the leaf, it is riddled with regular oval holes (*fig. C. b. b. b.*) corresponding with the glands. If, instead of examining merely the surface of the interior of the pitcher, you make a section of it, perpendicular to the surface, and through one of the glands (*fig. D.*), it will then be seen that

the gland (*a*) is really an oblong kernel, of hard, brown, minute cells, lying upon a quantity of thin-sided vesicles of the parenchyma, and kept in its place by the edge of the tough cuticle, which projects a little over the edge, and holds it firmly down; there is the more necessity for this arrangement, in consequence of the gland having no connection with the tissue it lies upon, further than it gains by being in contact with it. As glands are so often secreting organs, is it not probable that the secretion of fluid inside the pitcher of Nepenthes, may be owing to their presence? I have stated, that be their office what it may, they never occur any where except on the inside the pitcher; in Nepenthes distillatoria, they are not found near the top, although they are abundant on the inside the lid; in other species, the lid seems to be quite free from them, while the whole of the interior of the pitcher is covered with them. I have also, in one solitary instance, seen three of them on the outside of a pitcher near its base.

It is not merely in the cuticle of its pitchers, that Nepenthes has a curious anatomy. It is extremely well worth examination in other parts, and as we have all our microscopical apparatus in readiness, we may as well continue the investigation. Let us begin by making a very thin, transverse slice of the stem; this will shew you, that whether it is the soft parenchyma of a leaf or the firmer tissue of the bark, or the delicate and filmy cuticle, or the solid wood itself, all the parts of a plant consist of cells and tubes variously arranged. Having placed your slice on

the table of the microscope, in water, and illuminated it by light thrown from below, first remark the structure of the bark; it is a thick, firm layer of hexagonal cells, part of which (A. *f.*—*g.*) are arranged in one way, and part (A. *e.*—*f.*) in another, so that a stripe of the bark might without much difficulty, be split into two plates. Among the green cells of the bark, you will remark a few round white points; these are the mouths of fine, spiral-coated tubes, or *spiral vessels*. Between the bark and the wood is a thick layer (A. *d.*—*e.*) of exceedingly delicate, thin, green cells in which you may discern the round mouths of other tubes of various sizes; these are other spiral vessels of very large size, and in such abundance, that they look like a stratum of tow, between the wood and bark; each of these large spiral vessels is formed of four threads, twisted spirally. Next the spiral structure comes the wood, the outside of which (A. *c.*—*d.*) is hard, compact, and homogeneous, and then becomes, towards the centre (A. *b.*—*c.*), more open, with a quantity of unequal, round, or oval perforations, which are also the mouths of large spiral vessels; finally you come to the pith (A. *a.*—*b.*), consisting of thin-sided, large cells, in which are more mouths of vessels. All this is highly curious, and shews you what an infinite multitude of forces, represented by these little organs, are required to maintain the life of Nepenthes.

You will not, however, form a correct notion of their real nature, unless you also examine a longitudinal slice of the same part of the stem (*Plate* XLVII. B.); hitherto you have only seen the ends

of the cells and tubes; you are next to observe their sides; or otherwise you will not distinguish between tubes and cells. To begin again with the bark. You will now find that the cause of the different appearances in the two layers of the bark is owing to the outer layer (B. *f.*—*g.*) consisting of round cells, while the inner consists of long cells (B. *e.*—*f.*), whose principal diameter is parallel with the stem; of these two layers, the outer is purely parenchymatous, and analogous to the cortical integument, the inner is partly woody and analogous to the liber or inner bark of other Exogens. You will next see that the spiral stratum (B. *d.*—*e.*), is composed exclusively of thin roundish cells, and spiral vessels of the largest size; that the compact, homogeneous outside (B. *c.*—*d.*) is exclusively composed of woody tubes; that the wood itself (B. *b.*—*c.*) consists externally of woody tubes, which gradually, as they approach the pith, acquire an hexagonal form; and that in addition to the small spiral vessels lying amongst them, are some jointed, dotted tubes, which were not before distinguished; finally, that the pith is really composed of nothing but large, round polygons, mixed with great spiral vessels, as at first appeared.

You must not suppose that, because the Nepenthes is an Exogenous plant therefore all other Exogens have exactly this structure. On the contrary, Nepenthes is one of the greatest anomalies I am acquainted with, and stands quite alone, so far as observation has yet gone, in several parts of its anatomy. For instance, no other known plant has spiral vessels

any where except in the woody parts; Nepenthes produces them not only in the pith and the bark, but actually possesses a peculiar organ, as it would seem, expressly formed for their more abundant developement; namely, cellular stratum between the wood and bark. My object, therefore, in bringing these points to your notice, is not so much to illustrate general structure, as to acquaint you with a great singularity of structure.

If you now proceed to examine the cuticle, you will find even there a circumstance which is very unusual. The stomates on the outside the pitchers, and on the upper side of the leaf, are quite different. The cuticle of the upper side of the leaf (*Plate* XLVIII. D.), consists of lengthened meshes formed by the union of long cells; and among them are placed colourless, oval stomates (D. *a.* and B. *a.*), formed of a pair of parallel cells, and containing a good many particles of semi-opaque matter. But on the outside of the pitchers, the stomates are different in form and colour; the cuticle of this part has rounded meshes (*Plate* XLVIII. C.), among which lie roundish reddish stomates (C. *b.* and A. *a.*), not appearing to contain glandular matter, and consisting of four cells, of which the two central ones are much deeper coloured than the others. Moreover, below each of these stomates, in the inside of the leaf, are arranged six or seven angular, deep-red cells, which form a sort of internal gland, resting upon the stomate (C. *b.*). This circumstance seems connected with the glandular structure of the inside of the pitcher, and possibly will be

hereafter found another part of some wonderful adaptation of means to ends, which, although not capable of explanation in the present instance, we may feel perfectly persuaded of the existence of.

A slice of the firm tendril of this plant is so easily obtained, and shews so well the machinery by which that slender part bears its heavy pitcher, that I am sure you will be sorry to miss the opportunity of studying it. Take the finest imaginable transverse slice, and cut out of it a wedge (*Plate* XLVIII. E.), the top of which shall be the circumference, and the point the centre of the tendril. You will find that it is composed chiefly of roundish cells, the principal difference in which is, that those next the centre (*e.—f.*) have thinner and weaker sides than those next the circumference (*e.—d.*); and that the whole is bound together by a tough cuticle of small thick-sided cells (*d.—d.*). If the tendril were really composed of nothing more than this, it would have none of the requisite toughness and elasticity, either to support the weight of the plant, or to carry the pitcher; on the contrary, it would be brittle, like a piece of pith or a fungus. But upon looking more carefully at the section, you will perceive, near the centre, four or five little collections (E. *c.*) of thick-sided cells, surrounding a solid half moon (E. *f.*), and a small number of light, open, oval, or round spaces (E. *c.*), which you now know are the mouths of vessels; you will further note that the convexity of the half moon is towards the circumference of the tendril. A little way off the centre,

towards the circumference, you will find from sixteen to twenty more of these appearances (E. *f.*). They are caused by your having cut through the ends of highly elastic cords, consisting of spiral vessels (*b.* & *c.*), strengthened by a quantity of woody fibre (*f.*), and surrounded on all sides by tough, thick-sided cells; respiration goes on through the spiral vessels, circulation through the woody tubes, which also give strength and elasticity to the cords, and digestion through the surrounding cells. Moreover, near the circumference of the tendril (E. *a.*) these cords are repeated on a smaller scale, spiral vessels being placed in the centre, thick-sided cells on the outside, and a few tough, woody tubes immediately in contact with the spiral vessels; the object of these is no doubt to strengthen the tendril still further, and to do away with all possibility of the cords near the centre being accidentally broken.

Thus you see nature provides not fewer than sixty or seventy cords or muscles, each of a most wonderful degree of completeness, to give its requisite strength to a tendril, the diameter of which does not exceed the twelfth part of an inch. I am sure you will now agree with me, that however admirable the contrivances are, which readily meet the eye in the vegetable kingdom, there is something still more wonderful in the hidden and microscopic machinery, by which their organs are set in action.

EXPLANATION OF PLATE XLVII.

ANATOMY OF NEPENTHES.—A and B sections of a stem; *a—b.* the pith containing spiral vessels, lying in cellular tissue; *b—c* wood, consisting of long, lozenge-shaped, thick-sided cells, passing into rounded cells as they near the pith, of small spiral vessels and dotted vessels (or vasiform tissue) intermixed; *c—d* a homogeneous layer of woody tissue; *d—e* large, lax, thin-sided, cellular tissue, forming, with large spiral vessels, a layer between the wood and bark; *e—f* the liber or inner bark, and *f—g* the cortical integument, or outer bark, containing fine spiral vessels.——C. A portion of the cuticle of the inside of a pitcher, with the glands *a*, and the openings in the cuticle *b b*, left when the glands are removed.——D. A section of the pitcher, made perpendicular to the cuticle of the inside; *b b* cuticle closing in the gland, which is evidently a kernel of small hard brown cells.

EXPLANATION OF PLATE XLVIII.

ANATOMY OF NEPENTHES, continued.——A. A highly magnified view of a stomate *a*, and a portion of the cuticle on the outside of a pitcher. C. The same less magnified, seen from the under side; *a* the stomates; *b* the purple gland which reposes upon the stomates.—B. A highly magnified view of a stomate *a*, and a portion of the cuticle of the upper side of the true leaf.—D. The same less magnified; *a a* stomates.—E. A highly magnified segment of a transverse section of a tendril: *d d* cuticle; *a a* a row of elastic cords of vessels protected by woody fibre next the outside; *b*, *f*, and *c*, *f*, other elastic cords nearer the centre, *b* being the mouths of vessels, and *f* curved masses of woody tissue.

LETTER XLVII.

THE WATER PLANTAIN TRIBE—THE WATER LILY TRIBE.

(*Plate XLIX.*)

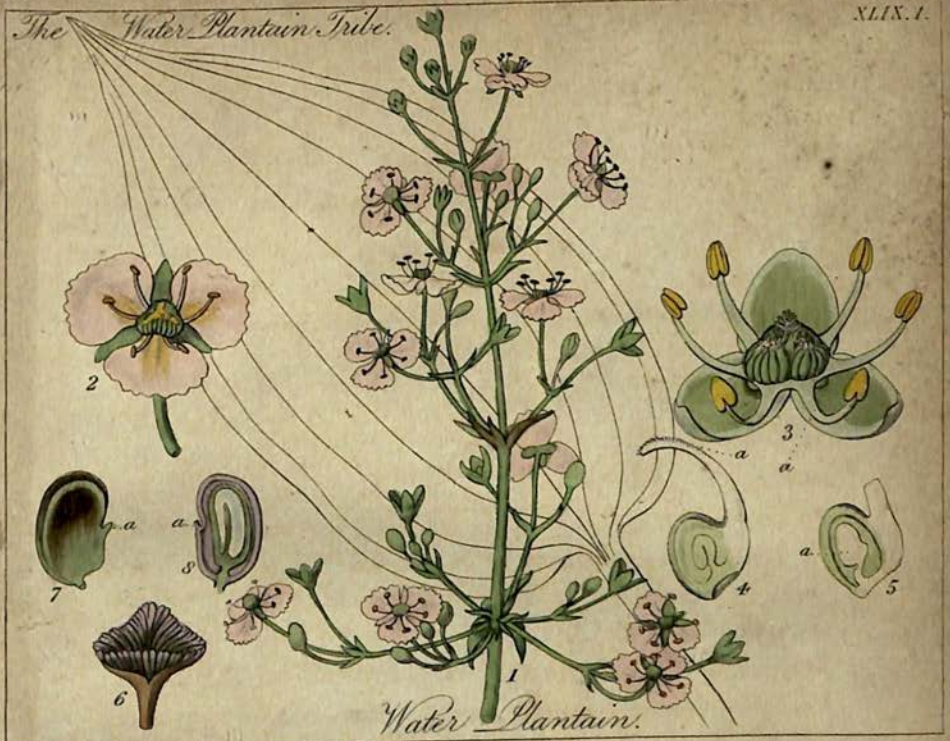
I HAVE now almost finished all the details about which I propose to occupy you, and so far as systematic Botany is concerned, I see no great object in pursuing the subject further. Indeed, to extend our correspondence much, would change the aim with which it was commenced; and you would be studying a long dissertation upon the Natural System of classification, instead of an introductory account of its elements.

There are, however, two natural orders of aquatic plants, both of which are common in this country, and about which a few remarks may be made with some advantage to you. The first is the WATER PLANTAIN TRIBE, the other the WATER LILY TRIBE.

The *Water Plantain* (Alisma Plantago), and the *Arrow-head* (Sagittaria sagittifolia), are two herbaceous plants, inhabiting the sides of ditches and ponds all over England. In most respects they are alike in the structure of their parts of fructification, differing principally in the latter having more stamens than the former, and these organs in different flowers from

The Water Plantain Tribe.

XLIX. 1.



Water Plantain.

The Water Lily Tribe.

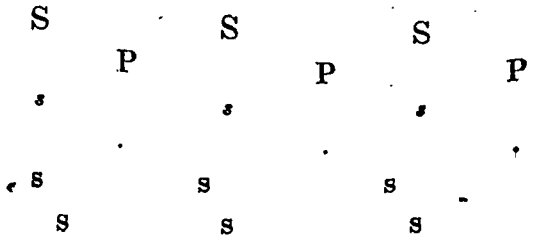
XLIX. 2.

White Water Lily.

the pistils. As the Water Plantain is the commoner of the two, let us look at it.

It has oblong, heart-shaped, pointed leaves, marked with about seven ribs, connected by transverse, oblique, forking and branching veins. The flowers are arranged in a loose, whorled, branching panicle (*Plate* XLIX. *fig.* 1.), at the base of each of whose whorl stand a few brown or green ovate bracts. The flowers (*fig.* 2) have a calyx of three green, permanent, blunt, parallel-veined sepals, and three delicate pink, or white, roundish, toothed petals.

There are six stamens placed in a very unusual manner, two opposite each sepal (*fig.* 3.); so that in this part of the fructification, Alisma is in a state that cannot be reconciled with the laws of structure before laid down. Upon a more minute examination, however, you will find a small round gland (*fig.* 3. *a.*) at the base of each sepal, and between each pair of stamens; this is obviously a rudimentary stamen, the number of which is thus increased to nine. But still the three stamens that ought to be placed opposite the petals are absent; and they must be considered altogether wanting; the six perfect stamens will belong to two succeeding whorls; so that, in reality, the flower of Alisma, although containing six stamens, or two whorls only, must be considered to be constructed upon a plan of twelve stamens in four whorls, of which the outer is rudimentary, the second deficient, and the two others consolidated into a single whorl; or the scheme of suppression of parts will be expressed thus:—



This is of more importance for you to know than you would at first suspect; for it indicates that Alisma although formed with only six stamens, has a tendency to produce twelve, and hence that it may belong to a tribe, the prevailing number of whose stamens is twelve or even more; and such is really the fact. Even in Alisma itself, the stamens are in other species nine, twelve or even more; and in Arrow-head they are in all cases very numerous. Had the six stamens of Alisma, belonged to the two first whorls, you would have had no reason to suppose, that although hexandrous, it might have immediate polyandrous affinities.

The ovaries of the Water Plantain are about twenty-four (that is, eight times three), arranged in a somewhat triangular manner; they are quite distinct from each other (*fig.* 4.), and consist of a single cell, from one side of the top of which the style arises in the form of a curved horn, the upper end of which is broken up into a stigma (*fig.* 4. *a.*). There is one ovule (*fig.* 5. *a.*) attached to the bottom of the cell, by a curved stalk.

The fruit (*fig.* 6.) is a triangular head of dry, one-seeded nuts, furrowed at the back, and marked with the base of the style on one side (*fig.* 7. *a.*).

From what has now been stated, can you tell whe-

ther this plant is an Exogen or an Endogen? Its leaves are in some measure those of both classes; and not exactly of either. The parallel ribs and netted intervals are, of the two, most like those of an Exogen. The branched *verticillate* inflorescence is most common in Exogens; but then it occurs continually among grasses. The ternary flowers are those of Endogens, but, again, there are many cases among Exogens where the ternary structure also exists: as in the Hepatica which is a Ranunculaceous plant. So far, therefore, as the structure of those parts you have been able to examine is concerned, the evidence seems pretty well balanced.

Perhaps affinity may settle the point. What is Alisma most like? You have no where seen in Endogens an example of numerous carpels and stamens; six, or three, or fewer, having been the prevailing number. We do not, therefore, seem likely to find a parallel in that class. Turn to Exogens, and especially to those which have numerous hypogynous stamens and carpels; and the memory immediately rests upon the Crowfoot Tribe. In that natural order, although the leaves are usually veined in the most legitimately Exogenous manner, yet in some, in the water species in particular, such as the common *tongue-leaved Crowfoot* (Ranunculus Lingua), the veins are disposed upon a plan strikingly similar to that of Alisma; in *Pilewort*, which is a species of Crowfoot (Ranunculus Ficaria), there are only three sepals; and in the *Mousetail* (Myosurus minimus), the stamens fluctuate between five and twenty. The fruit

of the Crowtoot Tribe often consists, as you know, of a considerable number of little, one-seeded, closed nuts, with an oblique style at the point; in short, in all these, and some other respects, Alisma is so like a Crowfoot, that it might actually be referred to the tribe of that name by any but a very cautious observer. The principal objection to its being placed in the Crowfoot Tribe, lies here; it is only now and then in Ranunculaceous plants that the number three occurs, and where it does exist, it is confined to the sepals or the petals, and is not found in the stamens or carpels; but in Alisma it occurs throughout every part; in the former, therefore, it may be regarded as an occasional deviation from a rule, while in the latter, it must be looked upon as the rule itself. In fact, the seed of Alisma, which in all these cases is the court of final appeal, shews that Alisma, is in reality, an Endogen.

If you open one of the nuts, you will find the seed standing erect (*fig.* 8.), and containing a monocotyledonous embryo, curved upon itself into the form of a horse-shoe.

The result of this examination shews how necessary it is, in doubtful points, to weigh and balance every thing that can be observed, and not to decide without the most careful investigation. In this case there was no real difficulty in arriving at the truth; it was only care and attention that were required.

The *white Water-Lily* (Nymphæa alba), although an aquatic like the Alisma, is in some respects very different. I select it as another case where a little

attention to the rule of evidence in Systematic Botany is required, in order to form a correct judgment. The stem of this plant affords no precise character, either one way or other, as between Exogens and Endogens. Its leaves, moreover, are referable, as much to the type of the one as of the other. Its flowers (*Plate* XLIX. 2. *fig.* 1.) consist of about twenty-five, thickish, oblong leaves, of a dazzling white colour, and the five external ones are more or less green at the back, in representation of a calyx; these leaves grow gradually smaller and smaller towards the centre, till at last their points become callous and yellow; at length bear a pair of short, anther lobes, in the room of the yellow callosity (*fig.* 3.); these again narrow into straps, having more perfect anthers at the points, (*fig.* 4.) and finally, next the ovary, shorten, diminish, and produce less perfect anthers. What I have called anther-bearing petals, are obviously stamens. Do not suppose that in this respect the Water-Lily offers an exception to general rules; in all cases the stamens are nothing but contracted and altered petals provided with anthers; only in the Water-Lily the transition is gradual and apparent, in others, it is too abrupt to be perceived. The number of the stamens is about fifty, but it is not fixed, nor indeed easily ascertained.

The ovary is in a curious state (*fig.* 2.); instead of being either altogether free, or altogether united with the calyx, it has the lower floral leaves free from it, and the upper united with it, so that the anther-bearing petals or stamens grow from just below the stigmas. It has ten or eleven cells, the partitions of which are

covered all over with ovules (*fig.* 5.), and the same number of orange-yellow stigmas, which spread away from the centre, like the rays of a poppy-head, to which they bear no little resemblance.

Is this plant an Exogen or an Endogen? Its leaves and stems afford no satisfactory information, and its habit, numerous stamens and carpels, would lead one to think that it bears the same relation to Alisma, as the Poppy to a Crowfoot. But the manifest tendency to the number *five* in the flowers of this plant, is fatal to the supposition; had the tendency been to *four*, the evidence would have still been inconclusive, for four does sometimes occur in the flowers of Endogens; but five, *never*. Therefore, without searching for the seed, the Water-Lily might be confidently considered a polypetalous Exogens; a conclusion confirmed by the seed, which is a little dicotyledonous body, lying in a bag, on the outside of a quantity of farinaceous albumen.

Besides this species, the *yellow Water-Lily* (Nuphar lutea) is extremely common in ponds. Take care, however, that you do not mistake for it the *Floating Buck-bean* (Villarsia nymphæoides), which is a monopetalous plant, belonging to an out-lying portion of the Gentian Tribe.

EXPLANATION OF PLATE XLIX.

I. The Water-Plantain Tribe.—1. A portion of the whorled panicle of *common Water-Plantain* (Alisma Plantago).—2. A complete flower. 3. A calyx, stamens, and pistil; *a a* the sepaline glands, or rudimentary stamens.—4. A carpel; *a* its recurved stigmatic face. 5. A section of the ovary, shewing the ovule *a*, elevated on its curved stalk.—6. A fruit.—7. One of the nuts much magnified; *a* the remains of the style.—8. A vertical section of the nut, shewing the seed with its horse-shoe embryo; *a* the base of the style.

II. The Water-Lily Tribe.—1. A flower of the *white Water-Lily* (Nymphæa alba).—2. A vertical section of the pistil, from which the petals, &c. have been cut away; *a a* first transition from petals to stamens; *b* perfect stamens; *c* diminished stamens.—3. A view of the front of a transition petal.—4. A complete stamen.—5. A transverse section of the ovary, with the ovules adhering to all the faces of the dissepiments.

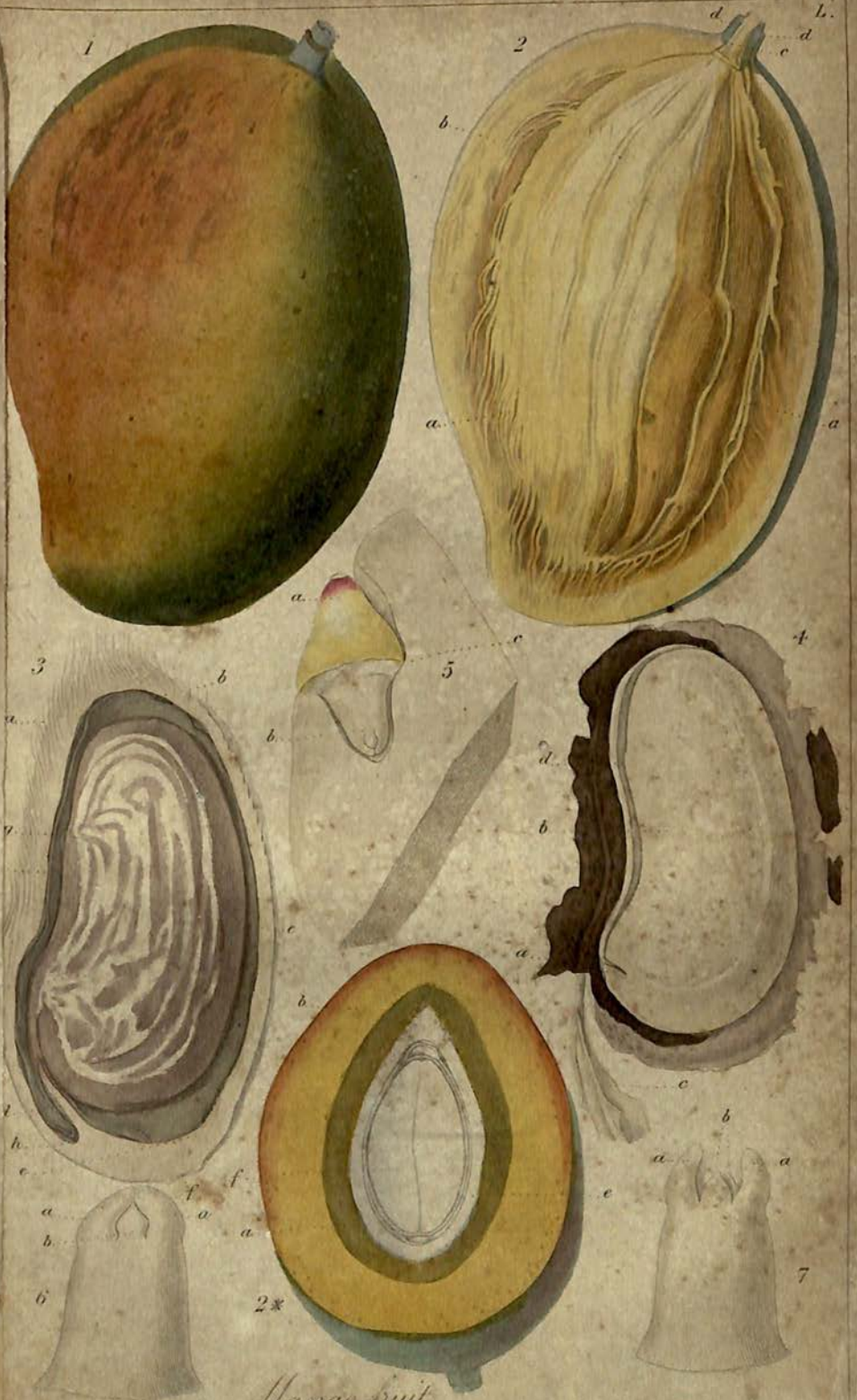
LETTER XLVIII.

THE RIPE FRUIT OF A MANGO.

Plate L.

I SEND you a beautiful drawing, by Mr. Francis Bauer, of the fruit of a Mango, a delicious tropical fruit, which has occasionally been brought to perfection in the hothouses of England, but which is better known in Europe in the form of a pickle. My object in placing the drawing in your hands is to shew you, by its means, something more of the internal structure of a fruit and a seed than you yet possess.

You must remember, that the type of all fruit is the carpel; that all carpels are formed upon one common plan, modified indeed to a great extent, by excessive growth; solidification, attenuation, or the like; and that fruits of every description are composed of one or more carpels, distinct or consolidated, and more or less altered by causes of the same nature as those which affect each separate carpel. So that, to understand the connection that exists between the parts of one ripe carpel, is to possess a standard, to which the peculiarities of all other carpels may be reduced. Nothing more instructive than the Mango can be taken.



Mango fruit.

Lith. del. Nov.r 1808.

The Mango (*fig.* 1.) is an oblong, rather kidney-shaped fruit, composed of an external succulent flesh (*fig.* 2. and 2. * *b.*), adhering to a fibrous woody shell (*fig.* 2. and 2.* *a.*), lined by a hard, homogeneous, brittle crust (*fig.* 2. * *e.*); the whole enclosing the seed (*fig.* 2. * *f.*).

The flesh, shell, and crust, taken together, are the pericarp. They are connected by a prodigious multitude of fibres, which pass from the shell into the flesh, where they lose themselves. The flesh and crust are a continuation of the bark of a branch (*fig.* 2. *d.*), the shell of the wood (*fig.* 2. *c.*), in the organic qualities of which they respectively participate.

The pericarp is theoretically analogous to a leaf rolled inwards, till its edges touch and grow together, so as to form a hollow case. The flesh is analogous to the parenchyma of the lower surface of the leaf, the shell to the veins, the crust to the parenchyma of the upper surface. The parenchyma of the leaf is an extension of the bark of the branch, and the veins of the wood, in the organic qualities of which they likewise participate.

In a leaf the veins convey liquid food from the wood, and deposit it in the parenchyma, where it is digested and altered, and whence it is slowly filtered back into the bark of the branch, which it descends. In the Mango fruit the liquid food is conveyed from the wood into the pericarp by the fibres of the shell, which pour it forth by their thousand mouths into the parenchyma, to be therein digested and altered; but in consequence of the narrowness of the stalk, the

cells through which it would have to filter are soon choked up, and then the altered food is forced to accumulate in the parenchyma (*fig.* 2. and 2. * *b.*). Being thus arrested in its course, it swells the tissue in which it lies, becomes more and more changed by constant exposure to light and air, till at last the succulent flesh of the Mango is the result.

As to the parenchyma of the inside of the pericarp, as it is cut off by the shell from all communication with the flesh, and is continually pressed upon by the seed as it grows, being thus jammed as it were between the shell and the seed, it is not unnatural that it should become so hard and solid as we find it.

The seed is attached to the bottom of the pericarp by a broad space (extending from *h* to *e* in *fig.* 3.), and stands erect in the cavity. It has two distinct skins, one of which (*fig.* 3. *b.*) is thin, pale, membranous and loose, the other and inner (*fig.* 3. *c.*) thicker, darker coloured, and fitting close to the embryo.

The inner skin does not grow from the same part of the pericarp as the outer, but springs from the top of a cord which arises obliquely from one side of the base (*fig.* 3. *d.* and 4. *c.*). From its junction with the inner coat to a small depression upon the edge (*fig.* 3. *g.*), the cord throws out veins which, taking a curved direction, and following the form of the embryo, fill the whole of the inner coat with a network of vessels.

The cord alluded to is the raphe, the depression upon the edge of the seed the centre of the chalaza,

and in the eyes of physiologists the true organic apex of the seed. It is obvious, therefore, that in this case the organic apex, and the apparent apex, are far from corresponding; and this is a very common occurrence.

The use of the vessels of the chalaza is doubtless to convey from the junction of the pericarp and branch (*fig.* 3. *f.*) the nutritious fluids required to enable the embryo to develope, and to change, from an opaque speck floating in jelly, to a large almond-like kernel.

The embryo is a large almond-like kernel (*fig.* 4. *b.*), composed of two plano-convex cotyledons, curved almost into the form of a kidney, and adhering by a point indicated externally by the small conical radicle (*fig.* 4. *a.*).

If you cut off the cotyledons, so as to get the radicle and plumule small enough to be conveniently magnified about four times, you will see that those two parts form a centre or axis of growth represented by two cones, of which the radicle (*fig.* 5. *a.*), lying in a niche of the cotyledons on the outside, is one, and the plumule (*fig.* 5. *b.*), enclosed between the bases of the cotyledons, is another. The cotyledons grow to the axis by a narrow space (*fig.* 5. *c.*).

The plumule (*figs.* 6. and 7.) is terminated at its point by four extremely minute leaves, crossing or alternating with each other in opposite pairs. Of these plumular leaves, the larger pair (*a. a.*) is external, and partly overlies the smaller (*b.*). The cotyledons themselves, which are larger still, cross or alternate with the outer pair of plumular leaves.

Such would be the position of any three pairs of opposite leaves upon a branch, as you may see by a Laurustinus, or a Sycamore tree; and hence they are all, cotyledons and plumular scales, considered rudimentary, or incompletely formed leaves.

If you can only understand that all fruits whatsoever are either multiplications of that of the Mango, with the addition perhaps of several seeds, and such alterations as I have already spoken of (p. 214), you may form a correct physiological notion of the essential parts of all theories concerning fruits and seeds. For the details relating to so exceedingly curious a subject, I must refer you to any very recent Introductions to Botany, in which the science is treated philosophically.

LETTER XLIX.

A SYSTEMATIC ARRANGEMENT OF PLANTS, ACCORDING TO THEIR NATURAL RELATIONS, OR SUMS OF RESEMBLANCE.

ALL that you have learned of the vegetable kingdom has been designedly desultory and unmethodical. My object has been not to engage your attention by explaining to you any particular system, but rather to store your mind with the facts upon which all systems must rest.

But as all systems of arrangement must be unintelligible to those unacquainted with details, so on the other hand must the most copious and well considered details be deprived of a great part of their value, if they are not so arranged as to illustrate and explain each other, as well as to be found whenever the memory seeks for them.

I shall, therefore, without further preface, give you in this letter a sketch of an arrangement of the commoner Natural Orders of plants, according to their resemblances; leaving you to make out the final distinctions between them by such means as you now possess; premising only, that throughout the whole of this compendium I have used the word *tribe*, as an equivalent for what is more generally termed a *natural order*.

There are five CLASSES into which all plants may be divided; namely—

I. EXOGENS, or DICOTYLEDONS; netted-leaved flowering plants, with two or more cotyledons to their embryo, and seeds enclosed in a seed-vessel.

II. GYMNOSPERMS; parallel-veined or fork-veined flowering plants, with two or more cotyledons to their leaves, and seeds formed without the protection of a seed-vessel.

III. ENDOGENS, or MONOCOTYLEDONS; parallel-veined flowering-plants, with only one cotyledon.

IV. RHIZANTHS; leafless parasitical flowering plants, with no cotyledons.

V. ACROGENS, or ACOTYLEDONS; plants having no true flowers that can be distinguished, and no cotyledons.

Each class is subdivided according to special rules, and must be treated of separately.

Class I. EXOGENS.

The SUBCLASSES are three; namely—

1. POLYPETALOUS plants; in which the petals are all distinct.
2. MONOPETALOUS plants; in which the petals are united into a tube.
3. *Incomplete* plants; in which there are no petals, and very often not even a calyx.

Each of these subclasses may be again subdivided into *groups*, as follows:—

Subclass I. Polypetalous Plants.

The *groups* are seven; namely—

1. *Albuminous;* a very *minute embryo* in the midst of a large quantity of albumen. This group is separated from the following, because of its remarkable character, and may comprehend all the modifications of structure by which the six following groups are known. In none of the latter is there an embryo much smaller than the albumen; so that, in analyzing the subclass, the student may divide it into two parts, one consisting of the albuminous group exclusively, and the other of the six other groups.
2. *Epigynous;* a large embryo; an *inferior ovary;* the placentation not parietal; the carpels consolidated; the calyx in a perfect whorl.
3. *Parietose;* a large embryo; an inferior or superior ovary indifferently; the *placentæ parietal;* the carpels consolidated; the calyx in a perfect whorl.
4. *Calycose;* a large embryo; a superior ovary; the placentæ not parietal; the carpels consolidated or not; the *calyx in a broken whorl.*
5. *Syncarpous;* a large embryo; a superior ovary; the placentæ not parietal; the *carpels consolidated; the calyx in a perfect whorl.*
6. *Gynobaseous;* a large embryo; a superior ovary; the *cells* of which are *placed obliquely round a conical centre,* and do not exceed five in number;

carpels consolidated or distinct; calyx in a perfect whorl.

7. *Apocarpous;* a large embryo; a superior ovary; *carpels distinct,* and not oblique, if five in number; calyx in a perfect whorl.

Each group is further subdivided into smaller clusters, called *Alliances;* but as you are not acquainted with a sufficient quantity of plants to appreciate such refinements, I shall in this and the succeeding classes simply place the orders you have studied, and a very few others, in little clusters under each of the foregoing groups: adding to their English names their more exact scientific denominations.

Group I. *Albuminous.*

a. The Crowfoot Tribe (Ranunculaceæ), Plate I. 1.
The Poppy Tribe (Papaveraceæ), Plate I. 2.
The Fumitory Tribe (Fumariaceæ).
The Water Lily Tribe (Nymphæaceæ), Plate XLIX. 2.

b. The Nutmeg Tribe (Myristicaceæ).
The Magnolia Tribe (Magnoliaceæ), Plate XXVI. 1.
The Anona Tribe (Anonaceæ).
The Dillenia Tribe (Dilleniaceæ).

c. The Umbelliferous Tribe (Apiaceæ or Umbelliferæ), Plate II. 1.
The Aralia Tribe (Araliaceæ)

d. The Gooseberry Tribe (Grossulaceæ), Plate XXVII. 1.
The Escallonia Tribe (Escalloniaceæ),

e. The Barberry Tribe (Berberaceæ), Plate XXVI. 2.
The Vine Tribe (Vitaceæ), Plate XXVII. 2.
The Pittosporum Tribe (Pittosporaceæ), Plate XXVIII. 1.
The Francoa Tribe (Francoaceæ).
The Sundew Tribe (Droseraceæ), Plate XXXIII. 2.
The Sidesaddle-flower Tribe (Sarraceniaceæ).

Group 2. *Epigynous.*

a. The Evening Primrose Tribe (Onagraceæ), Plate III. 1.
The Enchanter's Nightshade Tribe (Circæeæ).
The Combretum Tribe (Combretaceæ).
The Melastoma Tribe (Melastomaceæ).
The Myrtle Tribe (Myrtaceæ), Plate III. 2.
The Syringa Tribe (Philadelphaceæ).

b. The Dogwood Tribe (Cornaceæ).
The Miseltoe Tribe (Loranthaceæ).

c. The Gourd Tribe (Cucubitaceæ), Plate XXX. 2.
The Loasa Tribe (Loasaceæ).
The Cactus Tribe (Cactaceæ), Plate XXX. 1.
The Fig-Marigold Tribe (Mesembryaceæ), Plate XXXI. 2.
The Begonia Tribe (Begoniaceæ), Plate XXXI. 1.

Group. 3. *Parietose.*

a. The Cruciferous Tribe (Brassicaceæ or Cruciferæ), Plate IV. 1.
The Caper Tribe (Capparidaceæ), Plate XXIX. 2.
The Mignonette Tribe (Resedaceæ), Plate XXIX. 1.

b. The Violet Tribe (Violaceæ), Plate IV. 2.
The Frankenia Tribe (Frankeniaceæ).

c. The Passion-flower Tribe (Passifloraceæ), Plate V. 1.
The Turnera Tribe (Turneraceæ).

Group 4. *Calycose.*

a. The Guttiferous Tribe (Clusiaceæ or Guttiferæ).
The Tustan Tribe (Hypericaceæ), Plate V. 2.

b. The Tea Tribe (Ternströmiaceæ).

c. The Maple Tribe (Aceraceæ).
The Horse-chesnut Tribe (Æsculaceæ), Plate XXXVI. 1.
The Soap-berry Tribe (Sapindaceæ).
The Milk-wort Tribe (Polygalaceæ), Plate XXVIII. 2.

d. The Rock Rose Tribe (Cistaceæ), Plate XXXII. 2.
The Flax Tribe (Linaceæ), Plate XXXIX. 1.

Group 5. *Syncarpous.*

a. The Lythrum Tribe (Lythraceæ), Plate XXXII. 1.
The Mallow Tribe (Malvaceæ), Plate VI. 1.

The Sterculia Tribe (Sterculiaceæ).
The Linden Tribe (Tiliaceæ).

b. The Orange Tribe (Aurantiaceæ), Plate VI. 2.

c. The Buckthorn Tribe (Rhamnaceæ), Plate XXXVIII. 1.
The Euphorbia Tribe (Euphorbiaceæ), Plate XXXVIII. 2.
The Crowberry Tribe (Empetraceæ).
The Celastrus Tribe (Celastraceæ).
The Bladder-nut Tribe (Staphyleaceæ).
The Malpighia Tribe (Malpighiaceæ).

d. The Lychnis Tribe (Silenaceæ), Plate VII. 1.
The Chickweed Tribe (Alsinaceæ).
The Purslane Tribe (Portulacaceæ), Plate VII. 2
The Tamarisk Tribe (Tamaricaceæ), Plate XXXIII. 1.
The Knot-Grass Tribe (Illecebraceæ.)

Group 6. *Gynobaseous.*

a. The Rue Tribe (Rutaceæ), Plate XXXIX. 2.
The Bean-Caper Tribe (Zygophyllaceæ).
The Yellow-wood Tribe (Xanthoxylaceæ).

b. The Geranium Tribe (Geraniaceæ), Plate II. 2.
The Balsam Tribe (Balsaminaceæ).
The Nasturtium Tribe (Tropæoleæ).
The Wood-sorrel Tribe (Oxalidaceæ).

c. The Coriaria Tribe (Coriariaceæ).

d. The Limnanthes Tribe (Limnanthaceæ).

Group 7. *Apocarpous.*

a. The Rose Tribe (Rosaceæ), Plate VIII. 1.
The Apple Tribe (Pomeæ).
The Almond Tribe (Amygdaleæ).
The Burnet Tribe (Sanguisorbeæ).
The Pea Tribe (Leguminosæ), Plate VIII. 2.
The Carolina Allspice Tribe (Calcycanthaceæ).

b. The Saxifrage Tribe (Saxifragaceæ), Plate XXXVII. 2.
The Bauera Tribe (Baueraceæ).
The Houseleek Tribe (Crassulaceæ), Plate XXXVII. 1.

Subclass II. MONOPETALOUS PLANTS.

The *groups* are five; namely—

1. *Polycarpous;* ovary of *several carpels,* either distinct or consolidated, and *never inferior,* except in one case; fruit never bony and nut-like.
1. *Epigynous;* ovary of *several carpels,* either distinct or consolidated, and *inferior in all cases.*
3. *Aggregose;* ovary of *one carpel only,* and that either superior or inferior.
4. *Nucamentous;* ovary of two or more carpels, which change to *bony nuts* or seed-like pericarps, and are never inferior.
5. *Dicarpous;* ovary of *two carpels,* which are always *superior,* and do not change to bony nuts or seed-like pericarps.

The commoner natural orders belonging to these groups, are as follows:—

Group 1. *Polycarpous.*

a. The Winter-green Tribe (Pyrolaceæ).
The Monotropa Tribe (Monotropaceæ.)
The Heath Tribe (Ericaceæ), Plate XII. 1.
The Bilberry Tribe (Vaccinaceæ).
The Epacris Tribe (Epacridaceæ), Plate XLII. 2.

b. The Primrose Tribe (Primulaceæ), Plate XLII. 1.
The Myrsien Tribe (Myrsinaceæ).
The Holly Tribe (Aquifoliaceæ).
The Styrax Tribe (Styraceæ).

c. The Nolana Tribe (Nolanaceæ).
The Bindweed Tribe (Convolvulaceæ), Plate XII. 2.
The Dodder Tribe (Cuscutaceæ).
The Greek Valerian Tribe (Polemoniaceæ), Plate XLIII. 1.
The Diapensia Tribe (Diapensiaceæ).
The Hydrolea Tribe (Hydroleaceæ).

Group 2. *Epigynous.*

a. The Lobelia Tribe (Lobeliaceæ).
The Harebell Tribe (Campanulaceæ), Plate XIV. 1
The Stylidium Tribe (Stylidiaceæ).
The Goodenia Tribe (Goodeniaceæ).

b. The Coffee Tribe (Cinchonaceæ).
The Honey-suckle Tribe (Caprifoliaceæ), Plate XIV. 2.
The Madder Tribe (Galiaceæ, or Stellatæ), Plate XLIV. 1.

Group 3. *Aggregosæ.*

a. The Composite-flowered Tribe (Asteraceæ or Compositæ), Plate XVII. 1.
The Scabious Tribe (Dipsaceæ), Plate XLIV. 2.
The Valerian Tribe (Valerianaceæ).
The Brunonia Tribe (Brunoniaceæ).

b. The Rib-grass Tribe (Plantaginaceæ), Plate XVII. 2.
The Globularia Tribe (Globulariaceæ).
The Leadwort Tribe (Plumbaginaceæ).

Group 4. *Nucamentous.*

a. The Water-leaf Tribe (Hydrophyllaceæ).
The Borage Tribe (Boraginaceæ), Plate XV. 1.

b. The Mint Tribe (Lamiaceæ, or Labiatæ), Plate XVI. 1.
The Vervain Tribe (Verbenaceæ).
The Myoporum Tribe (Myoporaceæ.).

Group 5. *Dicarpous.*

a. The Trumpet-flower Tribe (Bignoniaceæ), Plate XLIII. 2.

b. The Justicia Tribe (Acanthaceæ).
The Butterwort Tribe (Lentibulaceæ).
The Gesnera Tribe (Gesneraceæ).
The Broom-Rape Tribe (Orobanchaceæ).
The Foxglove Tribe (Scrophulariaceæ), Plate XVI. 2.

c. The Nightshade Tribe (Solanaceæ), Plate XV. 2.

d. The Gentian Tribe (Gentianaceæ), Plate XIII. 1
The Wormseed Tribe (Spigeliaceæ).
The Apocynum Tribe (Apocynaceæ).
The Asclepias Tribe (Asclepiadaceæ), Plate XLV. 2.

e. The Olive Tribe (Oleaceæ), Plate XIII. 2.
The Jasmine Tribe (Jasminaceæ), Plate XLV. 1.

Subclass III. Incomplete Plants.

The *groups* are five; namely—

1. *Rectembryous;* calyx imperfect; *embryo straight.*
2. *Achlamydeous;* calyx entirely *wanting.*
3. *Tubiferous;* calyx *tubular,* often resembling a corolla; embryo straight; ovary usually one-celled.
4. *Columnous;* calyx perfect; ovary 3-6-*celled;* embryo straight.
5. *Curvembryous;* calyx perfect; *embryo curved* like a horse-shoe.

The common natural orders belonging to these groups are as follows:—

Group 1. *Rectembryous.*

a. The Oak Tribe (Corylaceæ or Cupuliferæ), Plate X. 2.
The Birch Tribe (Betulaceæ).
The Garrya Tribe (Garryaceæ).

b. The Nettle Tribe (Urticaceæ), Plate XI. 1.

The Elm Tribe (Ulmaceæ).
The Gala Tribe (Myricaceæ).
The Walnut Tribe (Juglandaceæ), Plate XXXVI. 2.

Group 2. *Achlamydeous.*

a. The Saururus Tribe (Saururaceæ).
The Pepper Tribe (Piperaceæ).

b. The Willow Tribe (Salicaceæ), Plate XI. 2.
The Plane Tribe (Platanaceæ).

c. The Callitriche Tribe (Callitrichaceæ).

Group 3. *Tubiferous.*

a. The Oleaster Tribe (Elæagnaceæ).
The Mezereum Tribe (Thymelaceæ), Plate XLI. 1.
The Protea Tribe (Proteaceæ), Plate IX. 1.

b. The Cinnamon Tribe (Lauraceæ), Plate XLI. 2.

Group 4. *Columnous.*

The Birthwort Tribe (Aristolochiaceæ), Plate XLVI. 1.
The Nepenthes Tribe (Nepenthaceæ).

Group 5. *Curvembryous.*

a. The Amaranth Tribe (Amaranthaceæ), Plate IX. 2.
The Goosefoot Tribe (Chenopodiaceæ), Plate XL. 2.
The Tetragonia Tribe (Tetragoniaceæ).
The Phytolacca Tribe (Phytolaccaceæ).
The Buck-wheat Tribe (Polygonaceæ), Plate XL. 1.

b. The Knawel Tribe (Scleranthaceæ).
The Marvel of Peru Tribe (Nyctaginaceæ), Plate X. 1.

Class II. GYMNOSPERMS.

The Fir Tribe (Pinaceæ or Coniferæ).
The Yew Tribe (Taxaceæ).
The Cycas Tribe (Cycadaceæ).
The Horsetail Tribe (Equisetaceæ).

Class III. ENDOGENS.

There are no subclasses; but there are five principal *groups*, viz.:—

1. *Epigynous; ovary inferior;* stamens and style distinct.
2. *Gynandrous;* ovary inferior; *stamens and style consolidated.*
3. *Hypogynous;* ovary superior; *flowers perfect.*
4. *Spadiceous;* ovary superior; *flowers usually in a spadix,* imperfect, either naked, or composed of a whorl of scales.
5. *Glumose;* ovary superior; *flowers* imperfect, *composed of* imbricated *ribbed bracts.*

Under these groups are arranged the following natural orders:

Group 1. *Epigynous.*

a. The Ginger Tribe (Zingiberaceæ).
The Arrow-root Tribe (Marantaceæ).
The Banana Tribe (Musaceæ).

b. The Narcissus Tribe (Amaryllidaceæ), Plate XVIII. 1.
The Cornflag Tribe (Iridaceæ), Plate XVIII. 2.
The Pine Apple Tribe (Bromeliaceæ).

Group 2. *Gynandrous.*

The Orchis Tribe (Orchidaceæ), Plate XIX. 2.
The Vanilla Tribe (Vanillaceæ).

Group 3. *Hypogynous.*

a. The Palm Tribe (Palmaceæ).

b. The Lily Tribe (Liliaceæ), Plate XX. 1.
The Asphodel Tribe (Asphodeleæ), Plate XIX. 1.
The Colchicum Tribe (Melanthaceæ).

c. The Spiderwort Tribe (Commelinaceæ).
The Flowering Rush Tribe (Butomoceæ).
The Water Plantain Tribe (Alismaceæ), Plate XLIX. 1.
The Rush Tribe (Juncaceæ), Plate XX. 2.

Group 4. *Spadiceous.*

a. The Arum Tribe (Araceæ), Plate XLVI. 2.
The Acorus Tribe (Acoraceæ).
The Bulrush Tribe (Typhaceæ), Plate XXI. 1.

b. The Naiad Tribe (Naiadaceæ).
The Arrow-grass Tribe (Juncaginaceæ), Plate XXI. 2
The Duckweed Tribe (Pistiaceæ), Plate XXI. 3.

Acrogens.

Group 5. *Glumose.*

The Grass Tribe (Craminaceæ), Plate XXII. 1.

The Sedge Tribe (Cyperaceæ), Plate XXII. 2.

Class IV. RHIZANTHS.

There are no plants of this class either cultivated in gardens, or wild in the North of Europe.

Class V. ACROGENS.

Neither subclasses nor groups are distinguished in this class; the commoner natural orders are—

a. The Fern Tribe (Filicales), Plate XXIII. 1.

The Club-moss Tribe (Lycopodiaceæ), Plate XXIII. 2.

The Moss Tribe (Bryaceæ or Musci), Plate XXIV. 1.

The Jungermannia Tribe (Jungermanniaceæ), Plate XXIV. 2.

The Liverwort Tribe (Marchantiaceæ or Hepaticæ).

b. The Chara Tribe (Characeæ).

c. The Mushroom Tribe (Fungaceæ), Plate XXV. 3.

The Lichen Tribe (Lichenaceæ), Plate XXV. 1.

The Sea-weed Tribe (Algaceæ), Plate XXV. 2.

LETTER L.

AN ARTIFICIAL METHOD OF DISCOVERING WITH CERTAINTY THE NATURAL ORDER TO WHICH A GIVEN PLANT BELONGS.

It is to be supposed that you are by this time well grounded in the distinctions of the commoner Natural Orders of plants; and my last letter will have furnished you with the means of arranging your knowledge in a methodical way. I, therefore, might with this have left you to your own resources in future, or have referred you to the higher systematical works of Botanists, for the means of carrying your inquiries further. But I am so anxious to remove every impediment from your path, that I have prepared for you a set of tables, by means of which you may with certainty discover to what Natural Order any given plant belongs, without being obliged to examine it so minutely as is in some instances necessary in a natural arrangement.

You will, doubtless, have remarked, that some of the distinctions between the groups, as disposed in my last letter, are minute, and difficult to discover; especially those which are taken from the structure of the seed. You will also find, in practice, that there are many exceptions to the characters of the subclasses and groups; for instance, *Virgin's Bower* (Clematis), *Spurge* (Euphorbia), *Mare's-tail* (Hippuris), and *La-*

dies'-mantle (Alchemilla), belonging to the Polypetalous subclass of Exogens, have in reality no petals; *Glaux*, belonging to the Monopetalous subclass of Exogens, has no petals; *Correa*, belonging to the Polypetalous subclass of Exogens, has a monopetalous corolla; and so on. No doubt, a Botanist who has had a little experience, overcomes these difficulties easily enough, because he will recognize the plants by the remainder of their structure, and notwithstanding their deviation from the general rule. But, although there exist exceptions to all rules whatsoever, and every person must, therefore, be accustomed to contend with them, whatever the branch of knowledge to which his studies have been directed; yet it must be confessed, that they are always very embarrassing to a beginner, and should be provided against by the best means that can be devised. Therefore, as my parting gift, and an appropriate conclusion to the correspondence that has passed between us, I send you a key, not only to all the Natural Orders of plants you have yet seen, but also to such others as you are at all likely to meet with.

It is only necessary for you to know how to use this key, and I confidently expect you will be at once relieved from all future embarrassment, both in distinguishing the orders themselves, and in guarding yourself against errors arising from exceptional cases. I would, indeed, advise you at first to use your key in all cases whatever, whether of doubt or not; for you will find it give you a habit of examining plants carefully, instead of looking at them superficially.

The principle upon which the key is constructed is

always to contrast characters in pairs, and to refer from one contrast to another, till at last there is nothing left out of which a further contrast can be drawn up; at that point, where comparison ceases, you ought to find the object of your search. This, which is called the dichotomous analysis, is that, in fact, which the human mind habitually, though unconsciously, employs in all its operations; and it possesses the great merit of being unerring, provided the comparisons are made with due caution. The best mode of instructing you how to use it, is to select a few examples; first, of plants conformable to the characters assigned to their orders; and, secondly, of others which offer exceptions to their characters.

The *Pellitory* (Parietaria officinalis), is a plan quite conformable to the characters assigned to its order. Take it as a test. You look to the first pair of characters, or *contrast No.* 1. in the table, and you have no difficulty in deciding that it belongs to "Plants having distinct and visible flowers;" the No. 2. at the end of that line carries you to *contrast No.* 2. where it agrees with "Leaves not veined," &c. Then, you proceed to No. 3. where you find that the Pellitory agrees with "Flowers incomplete, that is, having no corolla." You are now referred to No. 97, where you see that your plant corresponds with the character "Calyx present in some kind of state;" this takes you to No. 105, where you have no difficulty in selecting "Ovary superior," referring to No. 119. as that which suits your plant. At 119. "Leaves with stipules" corresponds with the Pellitory, and thus you

reach No. 120. At that point you, of course, take "Flowers unisexual," and so proceed to No. 121. Here you find "Carpels solitary," contrasted with "Carpels more than 1;" and it is obvious that your plant belongs to the first; it is, therefore, of the *Nettle Tribe*; and thus you have reached the desired information.

Let Sage (Salvia officinalis) be the next plant for trying the key. Without going over again the words of the earlier parts of the contrast, it is sufficient to say, that No. 1. refers you to No. 2., No. 2. to No. 3., No. 3. to No. 4., No. 4. to No. 157.; hence we will proceed more carefully. At this point "Ovary superior" sends you to No. 158.; thence "Flowers irregular" take you to No 185.; when there you have "Ovary four lobed," contrasted with "Ovary undivided," and as your Sage corresponds with the former, it belongs to the *Mint Tribe*.

Now, for a case or two of plants that do not correspond with all the characters assigned to the orders to which they belong. It is here that the tables should be of the greatest use; for the last thing which a student learns, is how to deal with exceptions. *Glaux*, a little coast plant, common on the sandy beach in many places, is a remarkable puzzle; it is destitute of corolla, and yet it belongs to the Monopetalous Primrose Tribe, with which it corresponds in every thing, except the presence of a corolla. You will readily detect its place in the system by the table. As before, No. 1. refers you to No. 2.; No. 2. to No. 3.; No. 3. to No. 97., where it corresponds with

"Calyx present in some kind of state," 105.; at that number "Ovary superior" carries you forward to No. 119.; at that point, "Leaves without stipules" refer you to No. 133.; there "Flowers bisexual" take you to No. 134.; thence "Sepals more than two," to No. 135. There you may be stopped by not knowing whether Glaux, with a one-celled ovary, and a free central placenta, belongs to 136 or 144.; but a little reflection will remind you, that such a structure is a consequence of the consolidation of several carpels (see Vol. 2. page 214.), and, consequently, you decide for No. 136.; at that contrast, "Placentas in the axis" correspond with your plant, and you move on to No. 137.; thence by "Number of ovules very great," to No. 140.; then by "Carpels consolidated at the point" to No. 141., whence "Stamens perigynous," carry you to No. 142., where, finally, you have the character "Fruit one-celled," which safely disembarks you in the desired haven, the land of the *Primrose Tribe.*

Another instance, and I have done. *Correa* a common, and very pretty genus of the Rue Tribe, has its petals united into a tube, so as to seem as if monopetalous, although the plant belongs to a polypetalous order. This, then, is a great puzzle to a beginner, and a fitting subject by which to try the goodness of the tables. You will first proceed from No. 1. to No. 2.; from No. 2. to No. 3.; and from No. 3. to No. 4. Here, if Correa were conformable to the character of its order, you would proceed to No 5.; but, as it is monopetalous, and, therefore, unconformable, you take

another road, and advance at once to No. 157. From that point, "Ovary superior" leads you to No. 158.; thence "Flowers regular" to No. 159.; from that you are conducted by "Ovary lobed" to No. 160.; where the "dotted leaves" fix your plant with the Rue Tribe, to which it really belongs.

Nothing can be more easy than the use of this table; and now that you possess it, I confidently expect that you will say in your next letter, "Now you *have indeed* shewn me the way out of my perplexities." Remember only that the table is not contrived to meet all cases whatsoever, for a great many Natural Orders are not even mentioned in it. It is only framed to enable you to master such difficulties as you, as a learner, may be expected to meet with, either in fields or gardens.

TABLE.

1.	Plants having distinct and visible flowers .	2
	Plants having no visible flowers .	225
2.	Leaves net-veined. Wood in concentric layers	3
	Leaves straight-veined, or feather-veined. Wood not in concentric layers .	205
3.	Flowers complete; that is, having both calyx and corolla . . .	4
	Flowers incomplete; that is, having no corolla	97
4.	Corolla polypetalous; that is, the petals distinct	5
	Corolla monopetalous; that is, the petals joined into a tube . . .	157

5. Stamens more than twenty . . . 6
   Stamens fewer than twenty . . . 31

6. Ovary inferior; that is, adhering to the calyx more or less 7
   Ovary superior; that is, not adhering at all to the calyx 14

7. Leaves with stipules . *The Apple Tr.*
   Leaves without stipules . . 8

8. Carpels more or less distinct from each other . . *The Bauera Tr.*
   Carpels wholly combined . . 9

9. Placentas spread over the whole surface of the partitions of the fruit *The Water Lily Tr.*
   Placentas confined to the centre or sides of the fruit 10

10. Placentas parietal; that is, adhering to the sides of the fruit . . 11
    Placentas central; that is, growing together in the middle of the fruit . . . 12

11. Petals few in number, and different from the sepals . . *The Loasa Tr.*
    Petals numerous, and undistinguishable from the sepals . . *The Cactus Tr.*

12. Leaves with little transparent dots *The Myrtle Tr.*
    Leaves quite opaque . . 13

13. Petals very numerous *The Fig-Marigold Tr.*
    Petals very few (4—5.) . *The Syringa Tr.*

14. Leaves with stipules . . 15
    Leaves without stipules . . 21

15. Carpels more or less distinct . . 16
Carpels wholly consolidated . . 17

16. Stamens hypogynous . *The Magnolia Tr.*
Stamens perigynous . *The Rose Tr.*

17. Æstivation of the calyx imbricated . 18
Æstivation of the calyx valvate . 20

18. Flowers unisexual; that is, stamens in one flower, and pistil in another *The Euphorbia Tr.*
Flowers bisexual; that is, with stamens and pistil in the same flower . . 19

19. Sepals two . . *The Purslane Tr.*
Sepals three or five . *The Rock Rose Tr.*

20. Stamens monadelphous; that is, united with each other in a tube . *The Mallow Tr.*
Stamens all distinct . *The Linden Tr.*

21. Carpels more or less distinct . . 22
Carpels quite consolidated . . 25

22. Stamens perigynous . . . *The Rose Tr.*
Stamens hypogynous . . . 23

23. Calyx in a broken whorl *The Tutsan Tr.*
Calyx in a perfect whorl . . 24

24. Acrid nauseous herbs *The Crowfoot Tr.*
Aromatic shrubs or trees *The Anona Tr.*

25. Fruit one-celled . . . 26
Fruit many-celled . . . 27

26. Ovary stalked. Sap watery *The Caper Tr.*
Ovary sessile. Sap milky . *The Poppy Tr.*

27. Placentas spread over the dissep. *The Water Lily Tr.*
Placentas in the axis of the fruit . 28

28. Stigma large broad and peltate *The Sidesaddle Tr.*
Stigma small and simple . . 29

29. Ovary one-celled . *The Purslane Tr.*
Ovary many celled . . . 30

30. Calyx tubular furrowed. Stamens perigynous *The Lythrum Tr.*
Calyx of three or five leaves in a broken whorl. Stamens hypogynous *The Rock Rose Tr.*

31. Ovary more or less inferior . . 32
Ovary entirely superior . . 44

32. Leaves with stipules . . . 33
Leaves without any stipules . . 34

33. Flowers unisexual . *The Begonia Tr.*
Flowers bisexual . *The Buckthorn Tr.*

34. Placentas parietal . . . 35
Placentas in the axis . . . 36

35. Flowers unisexual . . *The Gourd Tr.*
Flowers bisexual . . *The Currant Tr.*

36. Flowers in umbels *The Umbelliferous Tr.*
Flowers not in umbels . . 37

37. Carpels solitary . *The Combretum Tr.*
Carpels more than one . . 38

38. Carpels divaricating at point *The Saxifrage Tr.*
Carpels quite parallel and united . 39

39. Æstivation of calyx valvate . . 40
Æstivation of calyx imbricated . . 42

40. Fruit many seeded *The Evening Primrose Tr.*
Fruit very few seeded . . 41

41. Stamens opposite the petals *The Buckthorn Tr.*
Stam. alternate with the petals *The Dogwood Tr.*
42. Leaves dotted . . *The Myrtle Tr.*
Leaves not dotted . . . 43
43. Stam. doubled down in flower-bud *The Melastoma Tr.*
Stamens erect . *The Escallonia Tr.*
44. Leaves with stipules . . . 45
Leaves without stipules . . 60
45. Carpels distinct or solitary . . 46
Carpels consolidated . . . 48
46. Anthers with recurved valves *The Barberry Tr.*
Anthers with longitudinal valves . 47
47. Fruit a pod . . . *The Pea Tr.*
Fruit a capsule, or little drupe *The Rose Tr.*
48. Placentas parietal . . . 49
Placentas in the axis . . . 51
49. Flowers with filamentous crown *The Passion Fl. Tr.*
Flowers crownless . . . 50
50. Leaves circinate; that is, coiled up when young . . *The Sun-Dew Tr.*
Leaves straight when young . *The Violet Tr.*
51. Styles distinct to the base . . 52
Styles more or less combined . . 54
52. Flowers unisexual . *The Euphorbia Tr.*
Flowers bisexual . . . 53
53. Petals very minute . *The Knotgrass Tr.*
Petals very obvious . *The Saxifrage Tr.*
54. Æstivation of calyx imbricated . 55
Æstivation of calyx valvate . . 59

55. Leaves regularly opposite . . 56
Leaves alternate, or only occasionally opposite 57

56 Stem articulated; i. e. separating into distinct pieces at the joints . *the Bean-caper tr.*
Stem continuous. . *the Bladder Nut tr.*

57. Calyx in a complete whorl . . . 58
Calyx in a broken whorl . *the Soap-tree tr.*
Calyx of only two sepals . . *the Purslane tr*

58. Fruit beaked . . *the Geranium tr.*
Fruit not beaked . . *the Wood Sorrel tr.*

59. Stamens perigynous . *the Buckthorn tr.*
Stamens hypogynous . . *the Vine tr.*

60. Carpels more or less distinct, or solitary . 61
Carpels consolidated . . . 68

61. Anthers with recurved valves . *the Barberry tr.*
Anthers with longitudinal valves . . 62

62. Fruit a legume . . . *the Pea tr.*
Fruit not a legume . . . 63

63. Carpels with hypogynous scales . . 64
Carpels without hypogynous scales . 65

64. One hypog. scale to each carpel *the Houseleek tr.*
Two hypog. scales to each carpel *the Francoa tr.*

65. Cal. & cor. undistinguishable *the Carolina Allsp. tr.*
Calyx and corolla quite different . . 66

66. Herbaceous plants . . *the Crowfoot tr.*
Trees or shrubs 67

67. Cal. and cor. divided into threes . *the Anona tr.*
Cal. and cor. divided into fours . *the Coriaria tr.*

68. Fruit one-celled; if two-celled, then the dissepiment a spurious one . . 69
Fruit with several cells . . . 73
69. Stamens tetradynamous; that is, four long and two short . . *the Cruciferous tr.*
Stamens not tetradynamous . . 70
70. Hypogynous, disk large . . . 71
Hypogynous, disk absent 72
71. Ovary stalked . . . *the Caper tr.*
Ovary sessile . . *the Mignonette tr.*
72. Calyx 5-leaved . . . *the Turnera tr.*
Calyx 3 or 4-leaved . . *the Poppy tr.*
73. Placentas covering the dissep. *the Water-Lily tr.*
Placentas confined to the axis. . . 74
74. Styles distinct to the base . . . 75
Styles consolidated . . . 80
75. Calyx in a broken whorl . . . 76
Calyx in a perfect whorl . . . 77
76. Stamens in several parcels . *the Tutsan tr.*
Stam. in a perfect whorl (monadelphous) *Flax tr.*
77. Carpels each subtended by an hypogynous scale . . . *the Houseleek tr.*
Carpels scaleless 78
78. Carpels 2, divaricating at end *the Saxifrage tr.*
Carpels more than two, often with a free central placenta . . . 79
79. Calyx tubular . . *the Catchfly tr.*
Calyx 5-, or 4-parted . *the Chickweed tr.*
80. Æstivation of calyx imbricated . . 81
Æstivation of calyx valvate or open . 96

81. Sepals in a broken whorl . . . 82
Sepals in a complete whorl . . 85

82. Fruit splitting into valves . *the Horsechesnut tr.*
Fruit not splitting . . . 83

83. Calyx papilionaceous . *the Milkwort tr.*
Calyx uniform 84

84. Petals without appendages . *the Maple tr.*
Petals with appendages . *the Soap-tree tr.*

85. Flowers unisexual . . . 86
Flowers bisexual 87

86. Leaves dotted . *the Yellowwood tr.*
Leaves heath-like and dotless *the Crowberry tr.*

87. Leaves dotted 88
Leaves not dotted. . . . 89

88. Fruit a dry capsule . . *the Rue tr.*
Fruit a succulent berry . . . *the Orange tr.*

89. Flowers irregular . . *the Balsam tr.*
Flowers regular 90

90. Carpels four or more . . . 91
Carpels fewer than four . . . 93

91. Ovary 5-parted . . *the Limnanthe tr.*
Ovary undivided 92

92. Stamens distinct . . . *the Heath tr.*
Stamens monadelphous . *the Bread-tree tr.*

93. Calyx with two sepals . *the Purslane tr.*
Calyx with more than two sepals . . 94

94. Stamens hypogynous . . . 95
Stamens perigynous . *the Celastrus tr.*

95. Seeds with a tuft of hairs, or a hair . *Tamarisk tr.*
Seeds naked . *the Pittosporum tr.*

96. Seeds numerous . *the Lythrum tr.*
Seeds very few . *the Buckthorn tr.*

97. Calyx altogether absent . . 98
Calyx present in some kind of state . 105

98. Leaves having stipules . . 99
Leaves destitute of stipules . . 102

99. Ovules very numerous . *the Willow tr.*
Ovules very few 100

100. Carp. triple; i.e. 3 consolidated *Euphorbia tr.*
Carpels single . . . 101

101. Ovule erect; leaves fragrant . *the Gale tr.*
Ovule pendulous; leaves scentless *the Plane tr.*

102. Flowers unisexual . . 103
Flowers bisexual . . *the Pepper tr.*

103. Ovules naked; fruit in cones . the Fir tr.
Ovules covered 104

104. Carpels single . . *the Gale tr.*
Carpels double . *the Callitriche tr.*

105. Ovary more or less inferior . . 106
Ovary superior . . . 119

106. Leaves with stipules . . . 107
Leaves without stipules . . 109

107. Flowers bisexual . *the Birthwort tr.*
Flowers unisexual . . . 108

108. Fruit in a cup, or cupule . *the Nut tr.*
Fruit triangular, naked . *the Begonia tr.*

109. Flowers unisexual 110
Flowers bisexual 113

110. Flowers in catkins 111
Flowers not in catkins . . *the Gourd tr.*

111. Leaves simple 112
Leaves pinnated . . *the Walnut tr.*

112. Leaves opposite . . *the Garrya tr.*
Leaves alternate . . . *the Gale tr.*

113. Leaves with transparent dots . *the Myrtle tr.*
Leaves dotless . . . 114

114. Ovary many-celled . . . 115
Ovary one-celled . . . 116

115. Ovary three or six-celled *the Birthwort tr.*
Ovary four-celled *the Evening Primrose tr.*

116. Anther many-celled . *the Miselto tr.*
Anther two-celled . . . 117

117. Stamens numerous, long *the Combretum tr.*
Stamens few and short . . 118

118. Embryo straight *the Evening Primrose tr.*
Embryo curved . *the Goosefoot tr.*

119. Leaves with stipules . . . 120
Leaves without stipules . . 135

120. Flowers unisexual; that is, having stamens in one flower, and pistils in another 121
Flowers bisexual; that is, having stamens and pistils united in the same flower 123

121. Carpels solitary . . *the Nettle tr.*
Carpels more than one . . 122

122. Flowers in catkins . . *the Birch tr.*
Flowers not in catkins *the Euphorbia tr.*

123. Sepals two . . . *the Purslane tr.*
Sepals more than two . . 124

124. Carpels solitary, or quite separate . 125
Carpels more than one, consolidated . 128

125. Fruit a legume . . *the Pea tr.*
Fruit not a legume . . . 126

126. Calyx membranous . *the Knotgrass tr.*
Calyx firm and herbaceous . . 127

127. One style to each ovary . *the Rose tr.*
Three styles to each ovary *the Buckwheat tr.*

128. Placentas parietal . *the Passion Flower tr.*
Placentas in the axis . . . 129

129. Calyx membranous and ragged . *the Elm tr.*
Calyx firm and equally lobed . . 130

130. Calyx valvate . . . 131
Calyx imbricated . *the Geranium tr.*

131. Stamens monadelphous *the Sterculia tr.*
Stamens distinct . . . 132

132. Stam. 4-5, opposite the petals *the Buckthorn tr.*
Stamens 8-10 . . *the Linden tr.*

133. Flowers bisexual; that is, having both stamens and pistil in the same flower . . . 134

Flowers unisexual; that is, having stamens and pistils in separate flowers . 155

134. Sepals two . . *the Purslane tr.*
Sepals more than two . . 135

135. Carpels several, consolidated . . 136
Carpels solitary, or if several quite distinct 144

136. Placentas parietal . . . *the Poppy tr.*
Placentas in the axis . . 137

137. Number of ovules very small . . 138
Number of ovules very great . . 140

138. Leaves dotted . . *the Rue tr.*
Leaves not dotted . . . 139

139. Embryo curved . *the Virginian Poke tr.*
Embryo straight . . *the Celastrus tr.*

140. Carpels divaricating at point *the Saxifrage tr.*
Carpels consolidated at the point . 141

141. Stamens perigynous . . . 142
Stamens hypogynous . . . 143

142. Fruit one-celled . *the Primrose tr.*
Fruit with several cells . *the Lythrum tr.*

143. Calyx tubular . . *the Catchfly tr.*
Calyx of distinct sepals *the Chickweed tr.*

144. Carpels several . *the Crowfoot tr.*
Carpels solitary . . . 145

145. Anther-valves recurved . . 146
Anther-valves straight . . 147

146. Leafy, erect, shrubs or trees *the Cinnamon tr.*
Leafless, twining herbs *the Cassytha tr.*

147. Fruit a legume . . *the Pea tr.*
Fruit not a legume . . . 148

148. Calyx hardened in the fruit . . 149
Calyx always membranous . . 150

149. Base of calyx hardened *the Marvel of Peru tr.*
Whole tube of calyx hardened *the Knawel tr.*

150. Fruit triangular . *the Buckwheat tr.*
Fruit round . . . 151

151. Stam. in the points of the sepals *the Protea tr.*
Stamens not in the points of the sepals 152

152. Leaves covered with scurfiness *the Oleaster tr.*
Leaves not scurfy . . . 153

153. Cal. tubular. Ovule pendulous *the Mezereum tr.*
Calyx open and short. Ovule erect 154

154. Calyx dry and coloured *the Amaranth tr.*
Calyx herbaceous . *the Goosefoot tr.*

155. Stamens united in a column *the Pitcher-plant tr.*
Stamens distinct . . . 156

156. Leaves dotted . *the Yellowwood tr.*
Leaves not dotted . *the Euph. tr.*

157. Ovary superior . . . 158
Ovary inferior 194

158. Flowers regular . . . 159
Flowers irregular 185

159. Ovary lobed 160
Ovary not lobed . . . 162

160. Leaves dotted . . . *the Rue tr.*
Leaves dotless . . . 161

161. Flower-branches coiled up before opening *the Borage tr.*
Flower-branches always straight *the Nolana tr.*

162. Anthers opening by pores . 163
Anthers opening by slits . . . 166

163. Carpels four or five . . . 164
Carpels two . *the Nightshade tr.*

164. Herbaceous plants . *the Winter-green tr.*
Shrubs . . . 165

165. Anthers two-celled . *the Heath tr.*
Anthers one-celled . *the Epacris tr.*

166. Carpels four or five. . . 167
Carpels three . . . 172
Carpels two . . 174
Carpels one . . . 183

167. Stamens opposite petals, and equal to them in number. . . 168
Stamens alternate with petals, or at least twice their number . . 169

168. Herbaceous plants . *the Primrose tr.*
Shrubs and trees . *the Ardisia tr.*

169. Brown parasites on roots *the Monotropa tr.*
Leafy green plants . . 170

170. Seeds very numerous . *the Houseleek tr.*
Seeds very few . . . 171

171. Ovules erect . *the Bindweed tr.*
Ovules pendulous . *the Holly tr.*

172. Inflorescence coiled up . *the Hydrolea tr.*
Inflorescence straight . . 173

173. Anth. bursting longitud. *the Greek Valerian tr.*
Anthers bursting transversely *the Diapensia tr.*

174. Stamens two . . . 175
Stamens four or more . . 176

175. Æstivation of corolla valvate *the Olive tr.*
Æstivation of corolla imbricated *the Jasmine tr.*

176. Inflorescence coiled up *the Water-leaf tr.*
Inflorescence straight . . 177

177. Æstivation of corolla plaited . 178
Æstivation of corolla imbricated . 180

178. Seeds very few . *the Bindweed tr.*
Seeds very numerous . . 179

179. Leaves three-ribbed . *the Gentian tr.*
Leaves one-ribbed . *the Nightshade tr.*

180. Anthers adhering to a stigma-like table *the Asclepias tr.*
Anthers quite free . . 181

181. Parasitical leafless plants . *the Dodder tr.*
Green leafy terrestrial plants . . 182

182. Leaves uniformly three-ribbed *the Gentian tr.*
Leaves one-ribbed . *the Wormseed tr.*

183. Stigma with an external covering *the Brunonia tr.*
Stigma in its ordinary naked state . 184

184. Style one . . . *the Plantain tr.*
Styles five . . *the Leadwort tr.*

185. Ovary four-lobed . . *the Mint tr.*
Ovary undivided . . . 186

186. Carpel solitary . *the Madwort tr.*
Carpels two . . . 187

187. Fruit nut-like . . . 188
Fruit capsular or succulent . . 189

188. Flowers without bracts . *the Myoporum tr.*
Flowers with bracts . *the Vervain tr.*

189. Seeds winged. Woody climbers *the Trumpet-flower tr.*
Seeds wingless . . . 190

190. Brown parasites . *the Broom Rape tr.*
Green leafy plants . . . 191

191. Fruit two-celled . . . 192
Fruit with free centr. placenta *the Butterwort tr.*

192. Ovary partly inferior . *the Gesnera tr.*
Ovary quite superior . . 193

193. Seeds without appendages . *the Figwort tr.*
Seeds with hooked appendages *the Justicia tr.*

194. Carpel solitary . . . 195
Carpels more than one . . 197

195. Anthers grown together . *the Composite tr.*
Anthers distinct . . . 196

196. Carpel quite solitary . *the Scabious tr.*
Carpel with two additional abortive ones *the Valerian tr.*

197. Anthers grown together . *the Lobelia tr.*
Anthers distinct . . . 198

198. Anthers opening by pores . *the Bilberry tr.*
Anthers opening by slits . . 199

199. Stipules between opposite leaves *the Coffee tr.*
Stipules absent. . . . 200

200. Stigm. with an external covering *the Goodenia tr.*
Stigma naked . . . 201

201. Style and stamens united in an irritable column . . . *the Stylidium tr.*
Style and stamens distinct . . . 202

202. Seeds very numerous . *the Harebell tr.*
Seeds very few 203

203. Leaves alternate . . *the Ebony tr.*
Leaves opposite 204

204. Leaves in pairs. Stem round *the Honeysuckle tr.*
Leaves in whorls. Stem square *the Madder tr.*

205. Flowers incomplete; that is, not having distinct petals . . . 206
Flowers complete; that is, having distinct petals . . . 213

206. Flowers glumaceous . . 207
Flowers not glumaceous . 208

207. Stems round and hollow . *the Grass tr.*
Stems solid . . . *the Sedge tr.*

208. Flowers on a spadix . . 209
Flowers scattered . . 211

209. Fruit succulent . . *the Arum tr.*
Fruit dry 210

210. Anthers sessile . *the Acorus tr.*
Anthers on long weak stalks . *the Bulrush tr.*

211. Floaters . . . 212
Land plants . *the Arrow-grass tr.*

212. Ovules pendulous . *the Naiad tr.*
Ovules erect . . *the Duckweed tr.*

213. Stamens and styles united in a central column . . *the Orchis tr.*
Stamens and styles separate . . 214

214. Ovary inferior 215
Ovary superior . . . 219

215. Veins of leaves diverging from midrib 216
Veins of leaves parallel with midrib . 217

216. Anther two-celled . *the Ginger tr.*
Anther one-celled . *the Arrow-Root tr.*

217. Stamens three . *the Cornflag tr.*
Stamens six . . . 218
Stamens more than six . *the Frogbit tr.*

218. Sepals thin and coloured *the Narcissus tr.*
Sepals herbaceous . *the Pine-Apple tr.*

219. Carpels quite separate . . 220
Carpels quite united . . 221

220. Fruits many-seeded *the Flowering Rush tr.*
Fruits one-seeded *the Water-Plantain tr.*

221. Sepals herbaceous; petals coloured *Spiderwort tr.*
Sepals and petals both alike . 222

222. Flowers brown and glumaceous *the Rush tr.*
Flowers coloured . . . 223

223. Anthers turned outwards *the Colchicum tr.*
Anthers turned inwards . . 224

224. Petals rolled inwards after flowering *Pontedera tr.*
Petals shrivelling irregularly after flowering *the Lily tr.*

225. Stems jointed 225*
Stems not jointed . . 226

225* Fructification in cones *the Horsetail tr.*
Fructification axillary and solitary *the Chara tr.*
226. Plants with distinct leaves . . 227
Plants mere leafless expansions . 230
227. Fructification growing on the back of the leaves . . . *the Fern tr.*
Fructification distinct from the leaves 228
228. Seed-vessel sessile in the axils of leaves *the Club-moss tr.*
Seed-vessels on stalks . . 229
229. Seed-vessel with a lid and calyptra *the Moss tr.*
Seed vessel without lid and calyptra *the Jungermannia tr.*

230. Seed-vessel opening into valves *Jungermannia tr.*
Seed-vessel without valves . . 231
231. Seed-vessel stalked and external *Marchantia tr.*
Seed-vessel stalkless and usually internal 232
232. Growing under water *the Sea-weed tr.*
Growing in the air 233
233. Fructification in external shields *the Lichen tr.*
Fructification in internal cases *the Mushroom tr.*

APPENDIX.

An Alphabetical List of the commoner kinds of Plants, with the Natural Orders to which they severally belong.

	Tribe or Natural Order.
Abele Tree	Willow
Abies	Fir
Abrotanum	Composite
Abrus	Pea
Absinthium	Composite
Abutilon	Mallow
Acacia	Pea
Acanthus	Justicia
Acer	Maple
Aceras	Orchis
Achillea	Composite
Achyranthes	Amaranth
Aconitum	Crowfoot
Acorus	Acorus
Acrostichum	Fern
Actæa	Crowfoot
Acynos	Mint
Adam's Needle	Lily
Adder's tongue	Fern
Adenandra	Rue
Adenophora	Harebell
Adhatoda	Justicia
Adiantum	Fern
Adlumia	Fumitory
Adonis	Crowfoot
Adoxa	Aralia
Ægilops	Grass
Ægopodium	Umbelliferous
Aerides	Orchis
Æsculus	Horsechesnut
Æthionema	Cruciferous
Æthusa	Umbelliferous
African marigold	Composite
Agapanthus	Lily
Agave	Narcissus
Ageratum	Composite
Agrimonia	Rose
Agrostemma	Lychnis
Air plant	Orchis
Ajuga	Mint
Alaternus	Buckthorn
Albuca	Asphodel
Alcea	Mallow
Alchemilla	Burnet
Alder	Birch
Aletris	Asphodel
Alexanders	Umbelliferous
Alexandrian laurel	Asphodel
Alisma	Water Plantain
Alligator pear	Cinnamon
Allium	Asphodel
Allspice tree	Myrtle
Alnus	Birch
Aloe	Asphodel
Alonsoa	Foxglove
Alopecurus	Grass

	Tribe or Natural Order.
Aloysia	Vervain
Alpinia	Ginger
Alsine	Chickweed
Alstrœmeria	Narcissus
Althæa	Mallow
Alyssum	Cruciferous
Amaryllis	Narcissus
Amelanchier	Apple
American aloe	Narcissus
American cowslip	Primrose
Ammobium	Composite
Amomum	Ginger
Amorpha	Pea
Ampelopsis	Vine
Amsonia	Asclepias
Amygdalus	Almond
Anagallis	Primrose
Anagyris	Pea
Ananassa	Pine Apple
Anchusa	Borage
Andersonia	Epacris
Andromeda	Heath
Andropogon	Grass
Androsæmum	Apocynum
Anemone	Crowfoot
Anethum	Umbelliferous
Angelica	ditto
Angelonia	Foxglove
Angræcum	Orchis
Anomatheca	Cornflag
Anthemis	Composite
Anthericum	Asphodel
Antholyza	Cornflag
Anthriscus	Umbelliferous
Anthyllis	Pea
Antirrhinum	Foxglove
Aotus	Pea
Aphelandra	Justicia
Apios	Pea
Apium	Umbelliferous
Aponogeton	Saururus
Apricot	Almond
Aquilegia	Crowfoot
Arabis	Cruciferous
Arachis	Pea
Araucaria	Fir
Arbor Vitæ	do.
Arbutus	Heath
Archangel	Umbelliferous
Archangelica	ditto
Arctium	Composite
Arctotis	ditto
Ardisia	Myrsine
Areca	Palm
Arenaria	Chickweed
Aretia	Primrose
Argemone	Poppy
Aristolochia	Birthwort
Armeria	Thrift
Artemisia	Composite
Arthropodium	Asphodel
Artichoke	Composite
Artocarpus	Nettle
Arundo	Grass
Asarum	Birthwort
Asparagus	Asphodel
Asperula	Madder
Aspidium	Fern
Asplenium	do.
Aster	Composite
Astragalus	Pea
Astrantia	Umbelliferous
Astrapæa	Mallow
Astroloma	Epacris
Athamanta	Umbelliferous
Atragene	Crowfoot
Atriplex	Goosefoot
Atropa	Nightshade
Aubrietia	Cruciferous
Aucuba	Dogwood
Auricula	Primrose
Azalea	Heath
Azarolus	Apple
Babiana	Cornflag
Baccharis	Composite
Ballota	Mint
Balm	do.

	Tribe or Natural Order.
Balm of Gilead	Mint
Bamboo	Grass
Banksia	Protea
Baptisia	Pea
Barbarea	Cruciferous
Barleria	Justicia
Barley	Grass
Barringtonia	Myrtle
Bartonia	Loasa
Bartsia	Foxglove
Baryosma	Rue
Basil	Mint
Batatas	Bindweed
Batschia	Borage
Bauhinia	Pea
Bay tree	Cinnamon
Bean	Pea
Beaufortia	Myrtle
Beaumontia	Apocynum
Beccabunga	Foxglove
Beckmannia	Grass
Beech	Oak
Beet	Goosefoot
Belladonna Lily	Narcissus
Bellis	Composite
Bellium	ditto
Berberis	Barberry
Beta	Goosefoot
Betonica	Mint
Betula	Birch
Bidens	Composite
Bignonia	Trumpet Flower
Billardiera	Pittosporum
Billbergia	Pine Apple
Bird-cherry	Almond
Bird-pepper	Nightshade
Bird's-foot Trefoil	Pea
Biscutella	Cruciferous
Biserrula	Pea
Bitter-sweet	Nightshade
Bladder Ketmia	Mallow
Bladder Senna	Pea
Blechnum	Fern
Bletia	Orchis
Blitum	Goosefoot
Blue-bottle	Composite
Blumenbachia	Loasa
Bocconia	Poppy
Bœhmeria	Nettle
Boltonia	Composite
Bombax	Mallow
Bonapartea	Pine Apple
Bonus Henricus	Goosefoot
Boronia	Rue
Botrychium	Fern
Bouvardia	Coffee
Box Tree	Spurge
Brachysema	Pea
Brachystelma	Asclepias
Brake	Fern
Bramble	Rose
Brasavola	Orchis
Brassia	ditto
Brassica	Cruciferous
Broccoli	ditto
Brodiæa	Asphodel
Bromelia	Pine Apple
Bromus	Grass
Brook-lime	Foxglove
Broom	Pea
Broughtonia	Orchis
Broussonetia	Nettle
Browallia	Foxglove
Brownea	Pea
Brugmansia	Nightshade
Brunsfelsia	ditto
Brunsvigia	Narcissus
Bryonia	Gourd
Bryophyllum	Houseleek
Buddlea	Foxglove
Bugle	Mint
Bugloss	Borage
Bulbocodium	Colchicum
Bullace tree	Almond
Bupthalmum	Composite
Bupleurum	Umbelliferous
Burdock	Composite
Bur Reed	Bulrush

	Tribe or Natural Order.
Butcher's Broom	Asphodel
Butomus	Flowering Rush
Butterfly plant	Asclepias
Butterwort	Crowfoot
Buxus	Spurge
Cabbage	Cruciferous
Cacalia	Composite
Cæsalpinia	Pea
Caladium	Arum
Calamintha	Mint
Calandrinia	Purslane
Calanthe	Orchis
Calathea	Arrow root
Calceolaria	Foxglove
Calendula	Composite
Callicarpa	Vervain
Calliopsis	Composite
Callistachys	Pea
Callistemon	Myrtle
Calluna	Heath
Calochortus	Lily
Calostemma	Narcissus
Calothamnus	Myrtle
Calotropis	Asclepias
Caltha	Crowfoot
Calycanthus	Carolina All-spice
Calystegia	Bindweed
Camaridium	Orchis
Camellia	Tea
Cammarum	Crowfoot
Campanula	Harebell
Canarina	ditto
Canavalia	Pea
Candollea	Dillenia
Candytuft	Cruciferous
Canna	Arrow-root
Cannabis	Nettle
Canterbury Bells	Harebell
Capparis	Caper
Capraria	Foxglove
Caprifolium	Honeysuckle
Capsella	Cruciferous
Capsicum	Nightshade
Caragana	Pea
Caralluma	Asclepias
Caraway	Umbelliferous
Cardamine	Cruciferous
Cardoon	Composite
Carduus	ditto
Carex	Sedge
Carnation	Lychnis
Carob tree	Pea
Carrot	Umbelliferous
Carthamus	Composite
Caryophyllus	Myrtle
Cassia	Pea
Castanea	Oak
Castilleja	Foxglove
Caster-oil plant	Spurge
Catananche	Composite
Catchfly	Lychnis
Catmint	Mint
Cat Thyme	ditto
Cattleya	Orchis
Caucalis	Umbelliferous
Cauliflower	Cruciferous
Ceanothus	Buckthorn
Cedar of Lebanon	Fir
Cedar	ditto
Celandine	Poppy
Celery	Umbelliferous
Celosia	Amaranth
Centaurea	Composite
Centaurium	Gentian
Cephalanthus	Coffee
Cerastium	Chickweed
Cerasus	Almond
Ceratonia	Pea
Cerbera	Apocynum
Cercis	Pea
Cereus	Cactus
Cerinthe	Borage
Ceropegia	Asclepias
Ceterach	Fern
Chærophyllum	Umbelliferous
Chamomile	Composite

	Tribe or Natural Order.
Charlock	Cruciferous
Cheiranthus	ditto
Chelidonium	Poppy
Chelone	Foxglove
Chenopodium	Goosefoot
Cherimoyer	Anona
Cherry	Almond
Chervil	Umbelliferous
Chimaphila	Winter-green
Chimonanthus	Carolina Allspice
China Aster	Composite
Chionanthus	Olive
Chironia	Gentian
Chives	Asphodel
Chlora	Gentian
Chorizema	Pea
Christmas Rose	Crowfoot
Christ's Thorn	Buckthorn
Chrysanthemum	Composite
Chrysosplenium	Saxifrage
Cicer	Pea
Cichorium	Composite
Cicuta	Umbelliferous
Cimicifuga	Crowfoot
Cineraria	Composite
Circæa	Enchanter's Nightshade
Cissus	Vine
Cistus	Rock Rose
Citron	Orange
Citrus	ditto
Cladanthus	Composite
Clarkia	Evening Primrose
Clary	Mint
Claytonia	Purslane
Clematis	Crowfoot
Cleome	Caper
Clerodendrum	Vervain
Clethra	Heath
Clianthus	Pea
Cliffortia	Burnet
Clinopodium	Mint
Clintonia	Lobelia
Clitoria	Pea
Clover	ditto
Cobæa	Greek Valerian
Coburghia	Narcissus
Coccoloba	Buckwheat
Cochineal Fig	Cactus
Cochlearia	Cruciferous
Cock's-comb	Amaranth
Cocos	Palm
Colletia	Buckthorn
Collinsia	Foxglove
Collinsonia	Mint
Collomia	Greek Valerian
Colutea	Pea
Comarum	Rose
Commelina	Spiderwort
Comptonia	Gale
Conferva	Sea weed
Conium	Umbelliferous
Convallaria	Asphodel
Convolvulus	Bindweed
Coptis	Crowfoot
Corallorrhiza	Orchis
Corchorus	Linden
Coriander	Umbelliferous
Cork tree	Oak
Corn-cockle	Lychnis
Cornus	Dogwood
Coronilla	Pea
Coronopus	Cruciferous
Corræa	Rue
Cortusa	Primrose
Corydalis	Fumitory
Corylus	Oak
Costmary	Composite
Cotoneaster	Apple
Cotula	Composite
Cotyledon	Houseleek
Cow Parsley	Umbelliferous
Cowslip	Primrose
Crambe	Cruciferous
Crassula	Houseleek
Cratægus	Apple
Crinum	Narcissus

	Tribe or Natural Order.
Crithmum	Umbelliferous
Crocus	Cornflag
Crotalaria	Pea
Croton	Spurge
Crowea	Rue
Cucubalus	Lychnis
Cucumber	Gourd
Cucumis	ditto
Cucurbita	ditto
Cunninghamia	Fir
Cuphea	Lythrum
Cupressus	Fir
Curcuma	Ginger
Currant	Gooseberry
Cuscuta	Dodder
Cyclamen	Primrose
Cydonia	Apple
Cymbidium	Orchis
Cynanchum	Asclepias
Cynara	Composite
Cynoglossum	Borage
Cynosurus	Grass
Cyperus	Sedge
Cypripedium	Orchis
Cyrtanthus	Narcissus
Cyrtopodium	Orchis
Cytisus	Pea
Daffodil	Narcissus
Dahlia	Composite
Daisy	ditto
Dalbergia	Pea
Dalibarda	Rose
Damasonium	Water Plantain
Dammar	Fir
Dandelion	Composite
Daphne	Mezereum
Darwinia	Pea
Datura	Nightshade
Daucus	Umbelliferous
Davallia	Fern
Daviesia	Pea
Deadly Nightshade	Nightshade
Dead Nettle	Mint
Delphinium	Crowfoot
Dendrobium	Orchis
Dens Canis	Lily
Dentaria	Cruciferous
Desmodium	Pea
Dianthus	Lychnis
Dictamnus	Rue
Diervilla	Honeysuckle
Digitalis	Foxglove
Dillwynia	Pea
Dioscorea	Yam
Diosma	Rue
Dipsacus	Scabious
Disa	Orchis
Disandra	Foxglove
Dodecatheon	Primrose
Dolichos	Pea
Doronicum	Composite
Doryanthes	Narcissus
Dorycnium	Pea
Draba	Cruciferous
Dracæna	Asphodel
Dracocephalum	Mint
Dracontium	Arum
Drimia	Asphodel
Drosera	Sundew
Dryandra	Protea
Dryas	Rose
Duranta	Vervain
Eccremocarpus	Trumpet Flower
Echeveria	Houseleek
Echinocactus	Cactus
Echinops	Composite
Echites	Apocynum
Echium	Borage
Edwardsia	Pea
Elæagnus	Oleaster
Elichrysum	Composite
Elsholtzia	Poppy
Empetrum	Crowberry
Endive	Composite

	Tribe or Natural Order.
English Mercury	Euphorbia
Epidendrum	Orchis
Epigæa	Heath
Epilobium	Evening Primrose
Epimedium	Berberry
Epiphyllum	Cactus
Equisetum	Horsetail
Eranthemum	Justicia
Eria	Orchis
Erica	Heath
Eriobotrya	Apple
Eriophorum	Sedge
Eriostemon	Rue
Erodium	Geranium
Eruca	Cruciferous
Ervum	Pea
Eryngium	Umbelliferous
Erysimum	Cruciferous
Erythræa	Gentian
Erythrina	Pea
Erythronium	Lily
Eschscholtzia	Poppy
Esculus	Horsechesnut
Eucalyptus	Myrtle
Eucomis	Asphodel
Eugenia	Myrtle
Eulophia	Orchis
Euonymus	Celastrus
Eupatorium	Composite
Euphrasia	Foxglove
Eutoca	Waterleaf
Fagus	Oak
Farsetia	Cruciferous
Feather Grass	Grass
Fennel	Umbelliferous
Ferraria	Cornflag
Ferula	Umbelliferous
Feverfew	Composite
Ficaria	Crowfoot
Ficus	Nettle
Fig Tree	ditto
Filbert	Oak
Fontanesia	Olive
Fool's Parsley	Umbelliferous
Fragaria	Rose
Fraxinus	Olive
French Marigold	Composite
Fritillary	Lily
Fuchsia	Evening Primrose
Fucus	Sea-weed
Fumaria	Fumitory
Furze	Pea
Gagea	Lily
Galanthus	Narcissus
Galardia	Composite
Galega	Pea
Galeobdolon	Mint
Galeopsis	ditto
Galium	Madder
Gardenia	Coffee
Gardoquia	Mint
Gaultheria	Heath
Gaura	Evening Primrose
Genista	Pea
Gerardia	Foxglove
Germander	Mint
Gethyllis	Narcissus
Geum	Rose
Gilia	Greek Valerian
Gillyflower	Cruciferous
Gladiolus	Cornflag
Glaucium	Poppy
Glaux	Primrose
Glechoma	Mint
Gleditschia	Pea
Globe Amaranth	Amaranth
Globe Thistle	Composite
Gloxinia	Gesnera
Glycine	Pea
Glycyrrhiza	ditto
Gnaphalium	Composite
Gnidia	Mezereum
Goat's Beard	Composite
Golden Rod	ditto
Golden Saxifrage	Saxifrage
Gomphrena	Amaranth

	Tribe or Natural Order.
Gongora	Orchis
Goodia	Pea
Gordonia	Tea
Goteria	Composite
Gossypium	Mallow
Grape	Vine
Grape Hyacinth	Asphodel
Gratiola	Foxglove
Grevillea	Protea
Grewia	Linden
Griffinia	Narcissus
Grindelia	Composite
Grislea	Lythrum
Ground Ivy	Mint
Groundsel	Composite
Guava	Myrtle
Guelder Rose	Honeysuckle
Guernsey Lily	Narcissus
Guilandina	Pea
Gum Cistus	Rock Rose
Gymnocladus	Pea
Gypsophila	Chickweed
Habenaria	Orchis
Habranthus	Narcissus
Hæmanthus	ditto
Hakea	Protea
Halesia	Styrax
Halimodendron	Pea
Hamamelis	Witch Hazel
Hawkweed	Composite
Hawthorn	Apple
Hazel	Oak
Heart's Ease	Violet
Hedera	Aralia
Hedge Hyssop	Mint
Hedge Mustard	Cruciferous
Hedychium	Ginger
Hedysarum	Pea
Helenium	Composite
Helianthemum	Rock Rose
Helianthus	Composite
Helichrysum	ditto
Heliotropium	Borage
Hellebore	Crowfoot
Helonias	Colchicum
Hemerocallis	Lily
Hemimeris	Foxglove
Hemlock	Umbelliferous
Hemlock Spruce	Fir
Hemp	Nettle
Henbane	Nightshade
Hepatica	Crowfoot
Heracleum	Umbelliferous
Hermannia	Mallow
Hesperis	Cruciferous
Heuchera	Saxifrage
Hibbertia	Dillenia
Hibiscus	Mallow
Hieracium	Composite
Hippocrepis	Pea
Hippophae	Oleaster
Hippuris	Evening Primrose
Holly	Holly
Hollyhock	Mallow
Honesty	Cruciferous
Hop	Nettle
Horehound	Mint
Hornbeam	Oak
Horned Poppy	Poppy
Horseradish	Cruciferous
Hosackia	Pea
Hottonia	Primrose
Houseleek	Stonecrop
Houstonia	Coffee
Hovea	Pea
Hovenia	Buckthorn
Hoya	Asclepias
Humea	Composite
Humulus	Nettle
Hutchinsia	Cruciferous
Hyacinthus	Asphodel
Hydrocotyle	Umbelliferous
Hydrophyllum	Waterleaf
Hyoscyamus	Nightshade
Hypecoum	Poppy
Hypericum	Tutsan
Hypnum	Moss

	Tribe or Natural Order.
Hypochæris	Composite
Hypoxis	Narcissus
Hyssop	Mint
Iberis	Cruciferous
Ilex	Holly
Illecebrum	Knotgrass
Impatiens	Balsam
Imperatoria	Umbelliferous
Indian Fig	Cactus
Indian Corn	Grass
Indian Shot	Arrow Root
Indigofera	Pea
Inga	ditto
Inula	Composite
Ipomœa	Bindweed
Ipomopsis	Greek Valerian
Iris	Cornflag
Isatis	Cruciferous
Isopogon	Protea
Itea	Heath
Iva	Composite
Ivy	Aralia
Ixia	Cornflag
Ixora	Coffee
Jacaranda	Trumpet Flower
Jacobea Lily	Narcissus
Jambosa	Myrtle
Jasione	Lobelia
Jatropha	Spurge
Jerusalem Artichoke	Composite
Jonquil	Narcissus
Judas Tree	Pea
Juglans	Walnut
Jujube	Buckthorn
Julibrissin	Pea
Juniper	Fir
Kæmpferia	Ginger
Kalmia	Heath
Kaulfussia	Composite
Kennedia	Pea
Kerria	Rose
Kidney-bean	Pea
Kitaibelia	Mallow
Knautia	Scabious
Kölreuteria	Soapberry
Laburnum	Pea
Lachenalia	Asphodel
Lachnæa	Mezereum
Lactuca	Composite
Ladanum	Rock Rose
Ladies' Slipper	Orchis
Lagerstrœmia	Lythrum
Lambertia	Protea
Lamb's Lettuce	Valerian
Lamium	Mint
Lantana	Vervain
Lapeyrousia	Asphodel
Lapsana	Composite
Larix	Iris
Larkspur	Crowfoot
Larochea	Stonecrop
Laserpitium	Umbelliferous
Lasiopetalum	Sterculia
Lathyrus	Pea
Laurestinus	Honeysuckle
Laurus	Cinnamon
Lavandula	Mint
Lavatera	Mallow
Lavender	Mint
Leschenaultia	Goodenia
Ledum	Heath
Lemon	Orange
Leontice	Barberry
Leontodon	Composite
Leonurus	Mint
Lepidium	Cruciferous
Leptosiphon	Greek Valerian
Limnocharis	Flowering Rush
Linaria	Foxglove
Linnæa	Honeysuckle
Linum	Flax
Liparia	Pea
Liparis	Orchis

	Tribe or Natural Order.
Liriodendron	Magnolia
Lithospermum	Borage
Littorella	Ribgrass
Loddigesia	Pea
Lomaria	Fern
Lomatia	Protea
London Pride	Saxifrage
Lonicera	Honeysuckle
Lopezia	Evening Primrose
Loquat	Apple
Lotus	Pea
Lousewort	Foxglove
Lovage	Umbelliferous
Love Apple	Nightshade
Love-lies-bleeding	Amaranth
Lucern	Pea
Lungwort	Borage
Lupine	Pea
Lycium	Nightshade
Lycopodium	Clubmoss
Lycopsis	Borage
Lycopus	Mint
Lysimachia	Primrose
Macleaya	Poppy
Mahernia	Mallow
Mahonia	Barberry
Malcomia	Cruciferous
Malope	Mallow
Malva	ditto
Malvaviscus	ditto
Mammillaria	Cactus
Mandrake	Nightshade
Manettia	Coffee
Maranta	Arrow-root
Marica	Cornflag
Marigold	Composite
Marjoram	Mint
Marrubium	ditto
Marsh Mallow	Mallow
Maurandya	Foxglove
Maxillaria	Orchis
Mays	Grass
Medicago	Pea
Medlar	Apple
Melaleuca	Myrtle
Melhania	Mallow
Melianthus	Rue
Melilotus	Pea
Melissa	Mint
Melittis	ditto
Melon	Gourd
Melon Thistle	Cactus
Mentha	Mint
Menyanthes	Gentian
Menziesia	Heath
Mercurialis	Spurge
Mesembryanthemum	Fig Marigold
Mespilus	Apple
Meum	Umbelliferous
Milfoil	Composite
Mimosa	Pea
Mimulus	Foxglove
Mirabilis	Marvel of Peru
Mitella	Saxifrage
Momordica	Gourd
Monanthes	Stonecrop
Monarda	Mint
Moræa	Cornflag
Moricandia	Cruciferous
Morus	Nettle
Mountain Ash	Apple
Mucuna	Pea
Murraya	Orange
Murucuia	Passion Flower
Musa	Plantain
Muscari	Asphodel
Mustard	Cruciferous
Myosotis	Borage
Myrica	Gale
Myriophyllum	Evening Primrose
Myristica	Nutmeg
Myrrhis	Umbelliferous
Narthecium	Rush
Nasturtium	Cruciferous

	Tribe or Natural Order.
Navelwort	Borage
Nectarine	Almond
Negundium	Maple
Nemophila	Waterleaf
Neottia	Orchis
Nepeta	Mint
Nerine	Narcissus
Nerium	Apocynum
New Zealand Spinach	Tetragonia
Nicotiana	Nightshade
Nigella	Crowfoot
Nolana	Nolana
Nolitangere	Balsam
Nonea	Borage
Norfolk Island Pine	Fir
Norway Spruce	Fir
Nuphar	Water Lily
Nux-vomica	Apocynum
Nycterium	Nightshade
Nymphæa	Water Lily
Ocymum	Mint
Œnanthe	Umbelliferous
Œnothera	Evening Primrose
Olea	Olive
Oleander	Apocynum
Oncidium	Orchis
Onion	Asphodel
Onobrychis	Pea
Ononis	ditto
Onopordum	Composite
Onosma	Borage
Ophioglossum	Fern
Ophrys	Orchis
Opuntia	Cactus
Orach	Goosefoot
Origanum	Mint
Ornithogalum	Asphodel
Ornithopus	Pea
Ornus	Olive
Orobus	Pea
Orontium	Arum
Osbeckia	Melastoma
Osier	Willow
Osmunda	Fern
Ostrya	Oak
Othonna	Composite
Oxalis	Woodsorrel
Oxycoccus	Bilberry
Oxylobium	Pea
Pachysandra	Spurge
Pæonia	Crowfoot
Paliurus	Buckthorn
Pelma Christi	Spurge
Panax	Aralia
Pancratium	Narcissus
Papaver	Poppy
Pardanthus	Cornflag
Parietaria	Nettle
Paris	Colchicum
Parkinsonia	Pea
Parnassia	Saxifrage
Paronychia	Knotgrass
Parsley	Umbelliferous
Parsnip	ditto
Passerina	Mezereum
Pastinaca	Umbelliferous
Patersonia	Cornflag
Patrinia	Valerian
Pavetta	Coffee
Pavonia	Mallow
Peach	Almond
Pear	Apple
Pedicularis	Foxglove
Pelargonium	Geranium
Peltaria	Cruciferous
Pennyroyal	Mint
Pentapetes	Mallow
Penthorum	Stonecrop
Pentstemon	Foxglove
Peperomia	Pepper
Peppermint	Mint
Pereskia	Cactus
Pergularia	Asclepias
Periploca	ditto
Periwinkle	Apocynum

	Tribe or Natural Order.
Persoonia	Protea
Petunia	Nightshade
Phaca	Pea
Phacelia	Waterleaf
Phalangium	Asphodel
Pharnaceum	Chickweed
Phaseolus	Pea
Pheasant's Eye	Crowfoot
Phillyrea	Olive
Phleum	Grass
Phlomis	Mint
Phlox	Greek Valerian
Phormium	Lily
Photinia	Apple
Phycella	Narcissus
Phylica	Buckthorn
Phyllanthus	Spurge
Physalis	Nightshade
Pimelea	Mezereum
Pimenta	Myrtle
Pimpernel	Primrose
Pimpinella	Umbelliferous
Pinaster	Fir
Pinckneya	Coffee
Pine	Fir
Pink	Lychnis
Pinus	Fir
Pitcairnia	Pine Apple
Planera	Elm
Plantago	Ribgrass
Platanus	Plane
Plumbago	Leadwort
Plumieria	Apocynum
Podalyria	Pea
Podophyllum	Poppy
Poinciana	Pea
Polemonium	Greek Valerian
Polyanthes	Lily
Polyanthus	Primrose
Polygala	Milkwort
Polygonum	Buckwheat
Polypodium	Fern
Pomaderris	Buckthorn
Pomegranate	Myrtle
Poplar	Willow
Populus	ditto
Portugal Laurel	Almond
Portulaca	Purslane
Potato	Nightshade
Potentilla	Rose
Poterium	Burnet
Pothos	Arum
Pot Marigold	Composite
Prince's Feather	Amaranth
Prinos	Celastrus
Privet	Olive
Prunella	Mint
Prunus	Almond
Psidium	Myrtle
Psoralea	Pea
Pteris	Fern
Pulmonaria	Borage
Pulsatilla	Crowfoot
Pultenæa	Pea
Pumpkin	Gourd
Punica	Myrtle
Puschkinia	Asphodel
Pyracantha	Apple
Pyrola	Wintergreen
Pyrus	Apple
Quercus	Oak
Quince	Apple
Quisqualis	Combretum
Radiola	Flax
Radish	Cruciferous
Ragged Robin	Lychnis
Ragwort	Composite
Rampion	Harebell
Ranunculus	Crowfoot
Rape	Cruciferous
Raphanus	ditto
Raphiolepis	Apple
Rapistrum	Cruciferous
Raspberry	Rose
Red Cedar	Fir
Renanthera	Orchis

	Tribe or Natural Order.
Renealmia	Ginger
Reseda	Mignonette
Restharrow	Pea
Rhamnus	Buckthorn
Rheum	Buckwheat
Rhexia	Melastoma
Rhinanthus	Foxglove
Rhipsalis	Cactus
Rhodiola	Stonecrop
Rhododendron	Heath
Rhodora	ditto
Rhubarb	Buckwheat
Rhus	Cashew
Ribes	Gooseberry
Ricinus	Spurge
Robinia	Pea
Rose Acacia	ditto
Rose Campion	Lychnis
Rosemary	Mint
Rosmarinus	ditto
Rubia	Madder
Rubus	Rose
Rudbeckia	Composite
Rumex	Buckwheat
Ruscus	Asphodel
Russelia	Foxglove
Ruta	Rue
Saccharum	Grass
Saffron	Cornflag
Sage	Mint
Sagina	Chickweed
Sagittaria	Water Plantain
Saintfoin	Pea
St. John's Bread	ditto
St. John's Wort	Tutsan
Salicornia	Goosefoot
Salisburia	Fir
Salix	Willow
Salpiglossis	Foxglove
Salsafy	Composite
Salsola	Goosefoot
Salvia	Mint
Sambucus	Honeysuckle
Samolus	Primrose
Samphire	Umbelliferous
Sanguinaria	Poppy
Sanguisorba	Burnet
Sanicula	Umbelliferous
Sanseviera	Asphodel
Santolina	Composite
Saponaria	Lychnis
Satureja	Mint
Satyrium	Orchis
Savin	Fir
Savory	Mint
Scandix	Umbelliferous
Schizanthus	Foxglove
Schizopetalon	Cruciferous
Schœnus	Sedge
Scilla	Asphodel
Scleranthus	Knawel
Scolopendrium	Fern
Scolymus	Composite
Scoparia	Foxglove
Scorpiurus	Pea
Scorzonera	Composite
Scrophularia	Foxglove
Scurvy Grass	Cruciferous
Scutellaria	Mint
Sea Buckthorn	Oleaster
Sea Kale	Cruciferous
Sedum	Stonecrop
Sempervivum	ditto
Senecio	Composite
Sensitive Plant	Pea
Service	Apple
Sesleria	Grass
Shaddock	Orange
Shallot	Asphodel
Shepherdia	Oleaster
Sibbaldia	Rose
Siberian Crab	Apple
Sibthorpia	Foxglove
Sicyos	Gourd
Sida	Mallow
Sideritis	Mint
Sieversia	Rose

	Tribe or Natural Order.
Silene	Lychnis
Silphium	Composite
Sinapis	Cruciferous
Sisymbrium	ditto
Sisyrinchium	Cornflag
Sium	Umbelliferous
Smilacina	Asphodel
Smyrnium	Umbelliferous
Snapdragon	Foxglove
Snowball Tree	Honeysuckle
Snowberry	ditto
Snowdrop	Narcissus
Snowdrop Tree	Styrax
Solanum	Nightshade
Soldanella	Primrose
Solidago	Composite
Sonchus	ditto
Sophora	Pea
Sorrel	Buckwheat
Southernwood	Composite
Sowthistle	ditto
Sparaxis	Cornflag
Sparganium	Bulrush
Sparrmannia	Linden
Spartium	Pea
Spergula	Chickweed
Sphacele	Mint
Spinach	Goosefoot
Spindle tree	Celastrus
Spiræa	Rose
Sprengelia	Epacris
Spurge Laurel	Mezereum
Squill	Asphodel
Squirting Cucumber	Gourd
Stachys	Mint
Stachytarpheta	Vervain
Stanhopea	Orchis
Stapelia	Asclepias
Staphylea	Bladder-nut
Star of Bethlehem	Asphodel
Star of the Earth	Cruciferous
Statice	Leadwort
Stellaria	Chickweed
Sternbergia	Narcissus
Stevia	Composite
Stipa	Grass
Stock	Cruciferous
Stork's Bill	Geranium
Stramonium	Nightshade
Strawberry	Rose
Strawberry Blite	Goosefoot
Strawberry Tree	Heath
Strelitzia	Plantain
Struthiola	Mezereum
Stuartia	Tea
Styphelia	Epacris
Subularia	Cruciferous
Succory	Composite
Sugar Cane	Grass
Sunflower	Composite
Sutherlandia	Pea
Swainsona	ditto
Sweet Bay	Cinnamon
Sweet Briar	Rose
Sweet Flag	Acorus
Sweet Gale	Gale
Sweet Marjoram	Mint
Sweet Pea	Pea
Sweet Sultan	Composite
Sweet William	Lychnis
Sycamore	Maple
Symphoria	Honeysuckle
Symphytum	Borage
Syringa	Olive
Tacsonia	Passion-flower
Tagetes	Composite
Talinum	Purslane
Tamarindus	Pea
Tamarix	Tamarisk
Tamus	Yam
Tanacetum	Composite
Tare	Pea
Taxodium	Fir
Taxus	ditto
Teak Wood	Vervain
Teasel	Scabious
Tea Tree	Tea

	Tribe or Natural Order.
Tecoma	Trumpet-flower
Tectona	Vervain
Telephium	Stonecrop
Tellima	Saxifrage
Telopea	Protea
Templetonia	Pea
Terminalia	Combretum
Tetragonolobus	Pea
Teucrium	Mint
Thalictrum	Crowfoot
Thea	Tea
Theophrasta	Myrsine
Thermopsis	Pea
Thistle	Composite
Thlaspi	Cruciferous
Thorn Apple	Nightshade
Thrift	Leadwort
Thrincia	Composite
Thuja	Fir
Thunbergia	Justicia
Thyme	Mint
Tiarella	Saxifrage
Tigridia	Cornflag
Tilia	Linden
Tillandsia	Pine Apple
Tofieldia	Colchicum
Tormentilla	Rose
Trachelium	Harebell
Tradescantia	Spiderwort
Tragopogon	Composite
Trapa	Evening Primrose
Traveller's Joy	Crowfoot
Trefoil	Pea
Tree Onion	Asphodel
Trifolium	Pea
Trigonella	ditto
Trillium	Colchicum
Triteleia	Asphodel
Triticum	Grass
Tritoma	Asphodel
Trollius	Crowfoot
Tropæolum	Nasturtium
Tulip	Lily
Tulip Tree	Magnolia
Turnip	Cruciferous
Turritis	ditto
Tussilago	Composite
Typha	Bulrush
Ulex	Pea
Ulmus	Elm
Urtica	Nettle
Vaccinium	Bilberry
Valantia	Madder
Vallota	Narcissus
Vanda	Orchis
Vanguiera	Coffee
Vanilla	Vanilla
Vella	Cruciferous
Veltheimia	Asphodel
Venus' Fly-trap	Sundew
Venus' Looking-glass	Harebell
Veratrum	Colchicum
Verbascum	Foxglove
Verbena	Vervain
Veronica	Foxglove
Vesicaria	Cruciferous
Vestia	Nightshade
Vetch	Pea
Viburnum	Honeysuckle
Vicia	Pea
Vinca	Apocynum
Virgilia	Pea
Virginian Creeper	Vine
Virgin's Bower	Crowfoot
Viscum	Misseltoe
Vitex	Vervain
Vitis	Vine
Wallflower	Cruciferous
Water Cress	ditto
Water Hemlock	Umbelliferous
Water Horehound	Mint
Water Melon	Gourd
Watsonia	Cornflag

	Tribe or Natural Order.
Wayfaring-tree	Honeysuckle
Welsh Onion	Asphodel
Westringia	Mint
Wheat	Grass
White Cedar	Fir
White Clover	Pea
White Spruce	Fir
Whortle Berry	Bilberry
Winter Aconite	Crowfoot
Winter Cherry	Nightshade
Witheringia	ditto
Woodbine	Honeysuckle
Wood Sage	Mint
Woodsia	Fern
Woodwardia	ditto
Wormwood	Composite
Wulfenia	Foxglove
Xanthorhiza	Crowfoot
Xeranthemum	Composite
Xerophyllum	Colchicum
Xerotes	Rush
Yew Tree	Fir
Yucca	Lily
Zea	Grass
Zebra Plant	Arrow Root
Zephyranthes	Narcissus
Zieria	Rue
Zingiber	Ginger
Zinnia	Composite
Zizyphus	Buckthorn

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LADIES' BOTANY:

OR

A FAMILIAR INTRODUCTION

To the Study

OF THE

NATURAL SYSTEM OF BOTANY.

BY

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ETC. ETC. ETC.

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Dich verwirret, Geliebte, die tausendfältige Mischung,
Dieses Blumengewühls über dem Garten umher;
Viele Namen hörest du an, und immer verdränget
Mit barbarischem Klang, einer den andern im Ohr.
Alle Gestalten sind ähnlich, und keine gleichet der andern;
Und so deutet das Chor auf ein geheimes Gesetz,
Auf ein heiliges Räthsel. O! könnt ich dir, liebliche Freundinn,
Ueberliefern sogleich glücklich das lösende Wort.—GÖTHE.

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PREFACE.

This little book has been written in the hope that it may be found useful as an elementary introduction to the modern method of studying systematic Botany.

There are many works, of a similar description, to explain or illustrate the artificial system of Linnæus, the simplicity of which might have rendered such labours superfluous; but no one has, as yet, attempted to render the unscientific reader familiar with what is called the Natural System, to which the method of Linnæus has universally given way among Botanists. All seem curious to know something about this celebrated System, and many, no doubt, take infinite pains to understand it; but it is to be feared, that a large part of those who make the attempt, are far from meeting with the success their industry deserves. On all hands they are told of its difficulties; books, instead of removing those difficulties, only perplex the reader by multitudes of unknown words, and by allusions, which, however clear they

may be to the experienced Botanist, are anything rather than illustrative in the eyes of a beginner, who is often fairly lost in a labyrinth of resemblances, differences, and exceptions. One would think modern Botany was like "the art unteachable, untaught," only to be understood by inspiration.

The cause of this lies, not in the science itself, so much as in the books that are written concerning it. Since the appearance of my *Introduction to the Natural System of Botany* in 1830, several works of great merit have been published on the same subject, both in this country and abroad, so that the student is abundantly supplied with guides; and if his object be to understand it, as an important branch of Natural Science, they are sufficiently well adapted to his purpose; but for those who would become acquainted with Botany as an amusement and a relaxation, these works are far too difficult. Treating the subject, as they do in great detail, and without consideration for the unlearned reader, the language, the arguments, and the illustrations employed in them must be unintelligible to those who have no previous acquaintance with Botany; the characters of the Natural Groupes or Orders, into which the Vegetable Kingdom is divided, are not as a whole, susceptible of such an analysis as a young student is capable of

following; and I can quite understand how the whole system may appear to be an unintelligible mass of confusion. It has, therefore, occurred to me that if, without sacrificing Science, the subject should be divested of the many real and of the still greater number of imaginary difficulties that frighten students, and if they could be taught to recognize the Natural tribes of plants, not by mere technical characters, but by those simple marks of which the practised Botanist exclusively makes use, a work in which such objects are attained might be found of some utility.

It is now admitted on all hands that the principles of the artificial system of Linnæus, which were so important and useful at the time when they were first propounded, are altogether unsuited to the present state of science; and in the latest work that has been published in this country, upon that system, the learned and amiable author is forced to rest his defence of his still following it upon "the facility with which it enables any one, hitherto unpractised in Botany, to arrive at a knowledge of the genus and species of a plant." But if a system of Botany is to be nothing more than a contrivance to help those who will not master the elements of the science, to determine the name of a plant; and if it is really neces-

sary to have a mental rail-road on which such persons may be impelled without any exertion of their own; then indeed the analytical tables of the French are infinitely better contrivances than the Sexual System: because if well executed they meet every case and lead with certainty to positive results.

I have, however, been always at issue with the Linnean school of Botany as to their system accomplishing even the little that it pretends to; and if I may be permitted to appeal to my own personal experience of the difficulties of a beginner who is unassisted by a tutor, (and few could have had fewer difficulties to contend against than myself,) I should say that it is totally opposed to such a conclusion. I began with the Linnean system, which I was taught to believe little less than an inspired production; I had plenty of books compiled according to that system to consult, and I was fairly driven to seek refuge in the Natural System from the difficulties and inconsistencies of that of Linnæus.

It seems to me that there is a confusion of ideas in what is urged in favour of the Linnean system, and that its theoretical simplicity is mistaken for practical facility of application. That the principles of the Linnean system are clear, and simple, and easily remembered is indisputable; that student indeed

must be remarkably dull of apprehension, who could not master them in a day. But is its application equally easy? that is the point. When, for example, a specimen of a Monopetalous plant has lost its corolla, or when the stamens or pistils are absent, either accidentally, or constitutionally, as in Dicœcious plants, what Linnean Botanist can classify the subject of inquiry? Or where a genus comprehends species varying in the number of their stamens, as for instance, Polygonum, Salix, Stellaria, and hundreds of others, who is to say which of the species is to determine the classification of the rest? or when this point has been settled, how is the student to know what passed in the mind of the Botanical Systematist? The latter puts a genus into Octandria, because out of ten species, one has constantly, and two occasionally, eight stamens, and he includes in the same class and order, all the other species of the genus, although they have five, six, or ten stamens. Suppose the student meets with one of the last, and wishes to ascertain its name by the Linnean system, he will look for it in Pentandria, or Hexandria, or Decandria, where he will not find it. After wasting his time, and exhausting his patience in a vain pursuit, he must abandon the search in utter hopelessness, for there is no other character that he can make use

of as a check upon the first. At last some one will tell him that his plant is a Polygonum; he turns to his book, wondering how he could have overlooked it; and he finds Polygonum in Octandria. Should he inquire how this is, he will learn that his species belongs to Octandria, not because it is octandrous, *but because it is so very like other Polygonums that it cannot be separated from them, and they belong in most cases to Octandria.* This is the unavoidable answer; and what does it really mean, except that it is not in consequence of its accordance with the system that the student's Polygonum is to be discovered, *but in consequence of its natural relation to other Polygonums;* so that it is necessary to understand the Natural System, to make use of the Artificial System! This is no exaggerated case, but one of common occurrence. It is undoubtedly true that in some books such inconvenience is guarded against by special contrivances; but those contrivances form no part of the system.

Granting, however, for argument's sake, that these and other objections are overstated, and that the Linnean system does really facilitate the discovery of the class and order to which a plant belongs, let us next consider what advance towards the determination of the genus and species, or in other words the name of a plant, a student has really made, when the

class and order are ascertained. If this argument were conducted, as in strictness it ought to be, with reference to the whole Vegetable Kingdom, it would be easy to shew that the student had in fact gained almost nothing that is of use to him; but, in order to give the friends of the Linnean system every advantage in the discussion, we will confine the inquiry to the few hundred plants which grow wild in England. For this purpose take the generic characters in Diandria Monogynia, as stated in Dr. Hooker's British Flora, a work in which the subject is treated with all the skill and perspicuity of which it is susceptible, and in which the Linnean system is seen to the greatest advantage. The characters are these:—

* *Perianth double, inferior, monopetalous, regular.*

1. LIGUSTRUM. *Linn.* Privet.—*Cor.* four-cleft. *Berry* two-celled, with the cells two-seeded.

** *Perianth double, inferior, monopetalous, irregular. Seeds enclosed in a distinct pericarp (Angiospermous).*

2. VERONICA, *Linn.* Speedwell.—*Cor.* four-cleft, rotate, lower segment narrower. *Caps.* two-celled.

3. PINGUICULA, *Linn.* Butterwort.—*Cal.* two-lipped, upper lip of three, lower of one bifid segment. *Cor.* ringent, spurred. *Germen* globose. *Stigma* large, of two unequal plates or lobes. *Capsule*, one-celled, with the seeds attached to a central receptacle.

4. UTRICULARIA, *Linn.* Bladderwort.—*Cal.* two-leaved, equal. *Cor.*

personate, spurred. *Stigma* two-lipped. *Caps.* globose, of one cell. *Seeds* fixed to a central receptacle.

**** Perianth double, inferior, monopetalous, irregular. Seeds four, apparently naked (closely covered by the pericarp, Gymnospermous).*

5. LYCOPUS, *Linn.* Gypseywort.—*Cal.* tubular, five-cleft. *Cor.* tubular, *limb* nearly equal, four-cleft, upper segment broader, and notched. *Stam.* distant, simple.

6. SALVIA, *Linn.* Sage or Clary.—*Cal.* two-lipped, tubular. *Cor.* labiate, the tube dilated upwards and compressed. *Filaments* with two divaricating branches, one only bearing a perfect single *cell* of an *anther.*

***** Perianth double, superior.*

7. CIRCÆA. *Linn.* Enchanter's Nightshade.—*Cal.* two-leaved, but united into a short tube at the base. *Cor.* of two petals. *Caps.* two-celled; *cells* one-seeded.

****** Perianth single, or none.*

8. FRAXINUS, *Linn.* Ash.—*Cal.* O, or four-cleft. *Cor.* O, or of four petals. *Caps.* two-celled, two seeded, compressed and foliaceous at the extremity. *Seeds* solitary, pendulous. (Some flowers without stamens.)

9. LEMNA, *Linn.* Duckweed.—*Perianth* single, monophyllous, membranaceous, urceolate. *Fruit* utricular.

10. CLADIUM, *Schrad.* Twig-rush.—*Perianth* single, glumaceous. *Glumes* of one piece or valve, one-flowered, imbricating; outer ones sterile. *Fruit* a nut, with a loose external coat, destitute of bristles at the base.

This extract from the British Flora makes it evident that in determining to what genus a plant belongs, a great deal of inquiry beyond the discovery

that it has two stamens and one style, is indispensable. The student must be acquainted with the meaning of many technical terms, he must have his plant in different states of growth, he must procure the fruit, he must examine the interior of that part; in short, he must go through a long and careful examination, which is entirely independent of the Sexual System. In other and larger classes, such as Pentandria, Hexandria, Tetradynamia, Syngenesia, Gynandria, and Monœcia, the length and difficulty of such an examination, are much increased. Now I distinctly assert that in determining the Natural Orders of plants there is no difficulty greater than that of making out the genera in the Linnean system. In reality it is the same thing, only with a different result: in the one case it leads to the mere discovery of a name; in the other to the knowledge of a great number of useful and interesting facts independent of the name. This, which I hope will be evident from a perusal of the following Letters, is so strongly felt by all Botanists of any experience, that they never think of using the Artificial System themselves; they only recommend it to others.

There is, however, no mistake into which the public is apt tc fall much greater than the notion that Botany is a science of easy acquirement. Like

all other branches of Natural History, it is founded upon a close observation of numerous independent facts, and can only be understood as a science after long and attentive study; nevertheless a certain amount of it may be acquired without extraordinary application. The following pages will, it is hoped, explain sufficiently in what way this may best be done.

What I should recommend to those who take up this work with the intention of studying it, is to begin with the beginning, to follow it in the same order in which it is written, and to procure for examination the very flowers that are named in it; they are in most cases within the reach of all who live in the country. The specimens should be carefully compared with the descriptions and plates; and when they are all remembered and understood, you will be a Botanist;—not a very learned one—but acquainted with many of the fundamental facts of the science, and able to prosecute the inquiry to any further point, and to study other and more scientific works with ease and advantage.

The course to be pursued by those who would push their inquiries beyond the information in the present work should be of the following nature. They should read some Introduction to Botany, in which the modern views of structure and of vital action are well

explained; they should make themselves familiar with technical terms, which, although avoided in the following Letters, cannot be dispensed with in works of a more exact and scientific character; they may at the same time perfect themselves in a knowledge of common Natural Orders, by gathering the wild plants within their reach; comparing them with each other, and with the characters assigned to them in systematic works. Being thus provided with a considerable amount of precise fundamental knowledge, they may apply themselves to the study of the Natural System in its great features. They will then, and not till then, be able to appreciate the value of the modifications of organization connecting one tribe of plants with another, and to understand the infinite wisdom and beautiful simplicity of design which is so visible in the vegetable world; the just appreciation of which, through countless gradations of form, structure, and modes of existence, it should be the constant aim of the Botanist to demonstrate.

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The Crowfoot Tribe. Or. Ranunculaceæ. 1.1

Upright Meadow Crowfoot.

The Poppy Tribe. Or. Papaveraceæ. 1.2

Naked stalked Poppy

LETTERS ON BOTANY,

&c. &c.

LETTER I.

INTRODUCTORY REMARKS—FUNDAMENTAL TERMS—THE CROWFOOT TRIBE—THE POPPY TRIBE.

(Plate I.)

You ask me how your children are to gain a knowledge of Botany, and whether the difficulties which are said to accompany the study of this branch of science, cannot, by some little contrivance, be either removed altogether, or very much diminished.—Allow me, in answer to this question, to repeat a fable which I remember to have read in some French author.

A lady, observing some ants travelling across a table, dropped a lump of sugar in the midst of them; but, to her surprise, although ants are noted sugar-eaters, they all retreated in terror from the spot, nor could any of them afterwards find courage to return to examine the object of their dread; on the contrary, they chose another track, and carefully avoided that which would have proved a treasure had they known its value. Struck by the occurrence, the lady

placed the same piece of sugar on a part of the table near which the ants were in the habit of crossing, and when she saw one of them approaching it, she gently placed her finger in his way, so as to obstruct his passage without alarming him; the ant paused, looked around him. and then took a new direction, not exactly towards the sugar, but near it; the lady again opposed his passage gently, and at last, by making him take a sort of zigzag direction, tacking, as it were, at every few steps, the ant was unconsciously brought to the sugar without being frightened. Once there, he examined the glittering rock attentively, touched it with his antennæ, broke off a morsel, and hastened away with it to the ant-hill; whence he presently returned at the head of a host of his comrades, by whom the rest of the sugar was quickly carried off.

So it is with science and the young who have to acquire a knowledge of it. Let them be once alarmed at the aspect of their new pursuit, and it is almost impossible to restore their confidence; but there are few who, if led to it insensibly, will not persevere till they have made themselves masters of the subject.

The most discouraging parts of Botany to a beginner, consist either in the numerous new and strange names one has to learn the meaning of, or in the minuteness of the parts by which plants are distinguished from each other, or in the great multitude of species of which the vegetable kingdom consists; and it must be confessed, that there is something seriously

alarming in the mass of preliminary knowledge which it would appear has to be acquired before any perceptible progress can be made.

But if we look at the subject a little more closely, we shall find that, of the technical names employed, only a small number is really necessary in the beginning; that minute parts are little consulted in practice, however much they may be in theory; and that in consequence of the perfect arrangements of Botanists, no more inconvenience is experienced from the number of species, than in any other branch of Natural History.

There are certain terms, the exact meaning of which *must* be understood, and which cannot be dispensed with, if the science is to be studied to any good purpose; a sort of habit of observation has also to be acquired, without which the differences between one plant and another, can never be appreciated or remembered; but these things may be gained imperceptibly and without any extraordinary exertion either of industry or patience. We have only to begin with the beginning, and never to take one step till that which precedes it is secured; afterwards, the student may advance to what point he pleases. This appears to me to be the only secret in teaching Botany.

We must, however, be careful while we attempt to strip the study of its difficulties, that we do not also divest it of its interest, and imitate those who, by the ingenious substitution of words for ideas, have contrived to convert one of the most curious and interesting of all sciences into a meagre and aimless system of names.

Names are, no doubt, necessary for the purpose of distinguishing one thing from another; but, as no one would call that man a carpenter, who only knew the names of all the instruments in a carpenter's chest of tools, so neither can that person be considered a Botanist, whose knowledge is confined to the application of a few hundred Latin names to flowers and weeds. Were the latter the mark of a Botanist, then would every gardener be so accounted, which would be a great and grievous mistake.

"J'ai toujours cru," said Rousseau, whom I would at once have advised you to take as your guide, if his inimitable Letters were not both incomplete and obsolete,—"J'ai toujours cru qu'on pourrait être un très grand Botaniste, sans connaitre une seule plante par son nom,"—and to a great extent he was right. Only to apply their names to a few plants, is a poor insipid study, scarcely worth the following; but to know the hidden structure of such curious objects, to be acquainted with the singular manner in which the various actions of their lives are performed, and to learn by what certain signs their relationship, for they have their relations like ourselves, is indicated, is surely among the most rational and pleasing of pursuits.

It is only by acquiring a knowledge of the natural system of Botany, that you can systematically provide yourself with such information. If timid, or uninformed, or interested persons have alarmed you with an account of the difficulties of this mode of study, let me advise you to disbelieve them, and to give

your little people the opportunity of making the attempt. With such assistance as I shall be happy to give you, I cannot doubt of their succeeding.

You need not be told, that plants have generally five very distinct parts, viz. ROOT, STEM, LEAF, FLOWER, and FRUIT; the application of the three first of these terms, in their common acceptation, is already well known to you; the last is applied by Botanists, not only to such objects as apples, pears, cherries, and the like, but also to any part which contains the seed; so that the grains of corn, the heads of the poppy, the nuts of the filbert, and even the little bodies which are commonly called caraways, are all different kinds of fruit. These terms may pass without further explanation for the present.

It is in the flower that the beauty of plants chiefly resides; it is there that we find all the curious apparatus by means of which they are perpetuated, and it is the spot where the greatest number of parts are found, the names of which are unusual, and require to be remembered. To illustrate these let us take a very common plant, to be found in every meadow, by the learned called Ranunculus, by the vulgar Buttercup, or *Crowfoot.*

On the outside of the flower of this plant, about the middle of its stalk, are one or two little leaves, which look like the other leaves, only they are a great deal smaller; indeed, they are so small as to resemble scales; these are the BRACTS (Pl. I. 1. *a. a.*).

Next them, and forming the external part of the flower itself, are five small greenish-yellow hairy

leaves (*A. b.*), which are rather concave, and fall off shortly after the flower opens; leaves of this sort form the CALYX, and are called SEPALS; it is supposed that they are intended to protect the more tender parts of the flower, when the latter are very young and delicate.

Next the sepals are placed five other leaves, which are much larger, and of a bright shining yellow; they stand up and form a little cup, in the bottom of which the other parts of the flower are curiously arranged; these five shining yellow leaves form the COROLLA, and are called PETALS. They give all its gay and glittering appearance to the Crowfoot; which, when they have dropped off, is scarcely to be distinguished from the grass it grows among. Their business is, in part, to prepare the honey which exudes from a little scale you will find on their inside, near their base (*fig.* 1.), and, which, if secreted in sufficient quantity, is collected by bees for their sweet food; and it is, in part, to protect from injury the delicate organs which lie in their bosom. These last are of two sorts; as you will soon learn.

In a ring from which both the sepals and petals arise, you will find a number of little thread-like yellow bodies, which are thicker at the top than at the bottom; they spread equally round the centre, as if they wished to avoid that part, and are a great deal shorter than the petals; we call them STAMENS. Their lower part, which looks like a thread, is called the FILAMENT; their upper thickened end is named the ANTHER. This last part is hollow, and will be

found, if you watch it, to discharge a small quantity of yellow powder, called the POLLEN. The pollen has a highly curious office to perform, as will be shewn you presently.

Next to the stamens, and occupying the very centre of the flower, are a number of little green grains, which look almost like green scales; they are collected in a heap, and are seated upon a small elevated receptacle (*fig.* 3.); we call the whole collection of them the PISTIL, and each separate one a CARPEL. They are too small to be seen readily without a magnifying glass; but if they are examined in that way, you will remark that each is roundish at the bottom, and gradually contracted into a kind of short bent horn at the top; the rounded part (*fig.* 4. *a.*) is the OVARY; the horn (*b.*) is the STYLE; and the tip of the style (*c.*), which is rather more shining and somewhat wider than the style itself, is named the STIGMA; so that a carpel consists of ovary, style, and stigma. At first sight, you may take the carpels to be solid, and fancy them to be young seeds: but, in both opinions, you would be mistaken. The ovary of each carpel is hollow (*fig.* 5.); and contains a young seed called an OVULE (*fig.* 5. *d.*), or little egg; so that the carpel, instead of being the seed, is the part that contains the seed.

Although the ovule is really the young seed, yet it is not always certain that it will grow into a seed; whether or not this happens, depends upon the pollen, of which we have already spoken, falling upon the stigma. If the pollen does fall on the stigma, it

sucks up the moisture it finds there, swells, and finally each of the minute grains, of which it consists, discharges a jet of matter upon the stigma, which fertilizes the ovule, and then the latter grows and becomes a seed. But if the pollen does not fall upon the stigma, then the ovule withers away, and no seed is produced. Thus, you see every one of these parts of the flower is formed for some wise purpose. The sepals are to protect the petals; the petals to protect the stamens and carpels, and to form sugary food for their support; the stamens are to fertilize the ovules, and the carpels are to guard the young and tender seeds from injury; fertilization could not take place without the aid of the pollen; and the pollen could not produce its effect if it were not for the moisture and peculiar construction of the stigma. How admirable is the skill which is manifested in the construction of this little flower, and how striking a proof does it offer of the care with which the Creator has provided for the humblest of his works!

You have now seen all the parts of which flowers usually consist; the fruit is merely an alteration of the carpels, and the seed of the ovules. So perfect is the adaptation of the several parts to the end they have to perform, that it rarely happens that in the Crowfoot any of the ovules miss being fertilized. For this reason, the fruit of the Crowfoot is almost exactly the same when ripe as when young, except that its parts are larger, and it has become brown, dry and hard (*fig.* 6.). Separate, at this period, one of

the carpels from the remainder, and place it under the miscroscope; it will be found to resemble a seed very much in appearance, and indeed is often called by that name; but you have already seen, from an examination of the carpel, that the real seed is hidden in its inside; formerly fruits of this sort were called naked seeds; they are now called GRAINS; as for instance a grain of caraway, a grain of wheat, and so on.

What remains to be seen of the structure of the Crowfoot is very minute, and requires some expertness in the use of a dissecting knife and microscope to be easily made out. It is not, perhaps, very important that you should understand it; but, I may as well complete my account of the plant now that it is before us. I would recommend you to trust, at first, to the drawing that accompanies this; and not to waste your time in cutting up the grains, until you have well understood what it is you have to look for.

The inside of the grain is filled up with the seed, now arrived at its perfect state; the shell of the carpel has become hard and thick, and not only effectually protects the seed from harm (*fig.* 8. *a.*) but keeps it in the dark; another wise provision, for without darkness the seed could not grow. The shell thus altered is called PERICARP.

If you cut the seed through, you will, for a long time, discover nothing but a solid mass of white flesh, in which all the portions seem to be alike; but if you happen to have divided it accurately from top to

bottom, cutting through both edges of the grain, as at *fig.* 8, you will then be able to discover near the base of the seed a very minute oval body (*fig.* 8. *a.*), which may be taken out of the flesh with the point of a needle. This oval body is a young plant; it is the part which grows when the seed germinates, and is named the EMBRYO; the fleshy matter that surrounds it, called ALBUMEN, is only intended to nourish the young and delicate embryo, when it first swells and breaks through the shell. Small as is the embryo, so small as to be invisible to the naked eye, it also is constructed in a regular manner. It is not merely an oval fleshy body, but it has two differently organized extremities, of which the one is divided into two lobes, called COTYLEDONS (*fig.* 10.), or seed-leaves, and the other is undivided, and called RADICLE; the latter is the beginning of a root, as the former were the beginnings of leaves. Let the seed fall upon the earth, the embryo imbibes moisture, swells and shoots forth into a young plant, and thus the growth of the Ranunculus is renewed as soon as it is completed.

Such is the structure of a perfect flower, and such the principal terms which you have to remember, in order to understand the language of Botanists; other terms there are, besides these, which are equally essential, but they are not used so frequently, and it is not worth detaining you about them now. I shall explain them whenever we meet with them.

Having thus minutely examined the flower of the Crowfoot, let us next observe the way in which its other parts are formed.

The ROOTS of this plant consist of a number of little taper divisions, the points of which are very tender and easily bruised; from near the ends of these little divisions, you have a number of delicate fibres, also with soft and tender points. It is by these points that the root obtains its watery food, from out of the soil; and if you break off the points the plant will languish until the wounds are healed, and new and perfect rootlets formed; if it is unable to renew them it will die. This should always be thought of when you wish to transplant any thing; for the same circumstance occurs in all other plants, and the success of removing shrubs, or flowers, or trees, depends very much upon the points of the roots being preserved. In the gay Asiatic Ranunculus, which is so often cultivated by gardeners, for the sake of the gaudy colours of its beautiful double flowers, the roots at the time when they are taken out of the ground to be dried, have become so hard and tough, up to the very points, as not to be easily injured; yet it is possible even in this case to prevent the plants from producing healthy leaves, and well-formed flowers another season, if the roots are carelessly mutilated when taken up.

The LEAVES are dark-green, and very much divided into lobes, which are narrower in the leaves near the top of the stem than in those near the root. The business of these little appendages of the stem is not merely to render the face of nature pleasing to the eye by the charming verdure they produce; nor, as in such plants as have eatable leaves, to supply men and

animals with wholesome food. The plant itself could not grow without them; or, if it grew, could not bear fruit, but would totally perish as soon as it was born. The business of the leaves is to suck out of the stem the watery food which the roots had sucked out of the soil, and the stem out of the roots; and having filled themselves with it, to expose it to light and to air, to evaporate the superfluous part, and having thus in a manner digested it, to discharge it again back into the stem in the form of the peculiar matter which it may be the property of the plant to produce; such for instance as sugar in the Sugar Cane, flour in the Potatoe, gum in the Cherry Tree, a powerful medicinal substance in the Peruvian Bark tree, and poison in the Ranunculus itself. In order to enable the leaf to convey the watery food it sucks out of the stem to all parts of its own surface, and to return it back again, nature has furnished this little organ with a most curious and complicated arrangement of drains or conduits, consisting of excessively minute water-pipes glued together and branching in every direction; these are what we call veins; which you see in the Ranunculus are all joined together in the stalk of the leaf, but separate as soon as they enter the leaf itself, when they first divide into a few large arms, then subdivide into a number of smaller ones, and again divide over and over again until at last they form a net with meshes finer and more delicate than the most exquisitely manufactured lace. If you could examine the veins with a microscope you would find them still more curious in their structure than I have

represented them to be; for in the middle of every little vein is a sort of windpipe which conveys vital air to their extremest points.

Such is the way in which the veins of the leaf are disposed in the Crowfoot. It is very essential that you should pay attention to this netted branching arrangement, because one of the great natural divisions of the vegetable kingdom is to be known by that circumstance. One of the great natural divisions of plants is called EXOGENOUS, because the stems grow by addition to the outside of their woody centre; the same division is also called DICOTYLEDONOUS, because the embryo has two seed-leaves or cotyledons. You may generally recognize such plants by their leaves having netted veins; so that you see it is neither necessary to watch the stem to see how it grows, nor to examine the seed under a microscope in order to count the cotyledons, if you would ascertain whether a plant is Exogenous or not; the manifest arrangement of the veins in the leaf reveals the secret structure of the stem.

If you have rightly understood what I have explained thus far, you will not only have mastered several terms, but you will actually have made one important step in the study you have taken up: you will have become acquainted with the essential characters of a large and important natural order of plants, called the CROWFOOT TRIBE (or Ranunculaceæ), among which are some that are remarkable for the virulent poison which often lurks beneath their beautiful exterior. The Crowfoot genus itself contains

some species, such as that called "the wicked" (Ranunculus sceleratus), and another called "the burning" (R. acris), which will blister the skin if applied externally to the human body, or produce dangerous symptoms if taken into the stomach; these, however, are mild and harmless if compared with such as I shall presently mention to you. But first of all let us see in what the most essential character of the Crowfoot tribe consists.

By far the greater part of the characters which we have seen that the Crowfoot possesses, will be also found in other and extremely different plants; but there are two characters which are what we call *essential:* that is to say, such as will distinguish it and the other plants belonging to the same natural order, from other natural orders resembling it. These essential characters are, there being a great many stamens which arise from beneath the carpels, (which is what Botanists term being *hypogynous,* Pl. I. 1. *fig.* 3.); and also several carpels which are not joined together. If you will pay attention to these two circumstances, you will always know a Ranunculaceous plant, that is to say, a plant belonging to the Crowfoot tribe; and although you may not remember its name, you will know, what is of far more consequence, that it is, in all probability, a poisonous plant, and that its stem grows by addition to the outside of the woody centre, beneath the bark. A few instances of other genera, belonging to the same natural order, will put this in a clearer light.

There is a little annual, with leaves cut into divi-

sions as fine as hairs, and with small but rich dark scarlet flowers, called Adonis, or *Pheasant's eye.* This plant agrees with the Crowfoot in its structure, in almost every point: but its petals have not a scale near their base, on which account Adonis is reckoned a plant of the same tribe, but is separated as a distinct genus.

Another and charming little collection of pretty flowers is formed by the *Anemones,* with their purple, or white, or scarlet petals, which modestly hang their heads, as if unwilling to expose their beauty to every curious eye. These have the calyx and corolla mixed together, so that you cannot distinguish the one from the other; and when their flowers are gone, they bear little tufts of feathery tails, or oval woolly heads, in the place of the clusters of grains which you found in the Ranunculus. Such tails or heads of wool, are collections of the grains of the Anemone, and contain the seeds; the tails themselves are nothing but the styles of the carpels, grown large and hard and hairy; they are thought to be intended by nature as wings, upon which the grains may be carried by the wind from place to place. If you look at the leaves, or the stamens, or the young carpels, or the ripe seeds of the Anemone, you will find all those parts constructed, in every essential respect, like the Crowfoot. *Hepaticas,* which you have so often seen thriving, when neglected, in a cottage garden, when, perhaps, they perished under your own continual care, as if they were created specially for the pleasure of the poor, are nothing but Anemones, with

three bracts underneath the flower, and either six or nine sepals and petals.

You have seen the *Globe-flowers* (Trollius), with their yellow heads, in the borders among American plants; these have a great many sepals, which give the beauty to their flowers; their petals are little strap-shaped bodies lying on the outside of the stamens; and each of their carpels contains several seeds; in this they differ from the Crowfoots, but otherwise resemble them so much, that before the flowers appear, you would take the Trollius for a Ranunculus.

Marsh Marigold, again (Caltha), which grows in large green tufts in the meadows, and by the sides of ditches, differs from the Globe-flower in having no petals at all. *Christmas Roses* (Helleborus), and *Winter Aconites* (Eranthis), are also of the Crowfoot tribe; each differing in one respect or other from those I have mentioned, but possessing the essential characters already explained.

All the plants yet mentioned, are so like the Ranunculus, that it is impossible to overlook their resemblance, even if it were not pointed out. But there are some others in which the resemblance is less striking at first, although it is equally great when understood. Who has not heard of Larkspurs? Rocket Larkspurs, with their spikes of white, and pink, and purple starry flowers; of Bee Larkspurs, which look as if the insect from which they take their name were glued to their inside; or Siberian Larkspurs, with their branches of blue flowers, which no gem nor mineral can emulate in brightness, or

deepness of colour? These are of the Crowfoot tribe, but less closely allied to Ranunculus itself, than what I have already mentioned. We are so accustomed to combine in our minds the idea of Buttercups and yellowness; that we are apt to overlook the resemblance which really exists between the Ranunculus and the Larkspur, because of the want of yellow in the latter. But setting aside this, which is of no Botanical importance whatever, let us look at the calyx of the Larkspur (Delphinium). It is composed of five leaves, or sepals, the uppermost of which has a horn arising from out of its back; so is that of Ranunculus, excepting the horn. It has four petals, of which two have long tails, hidden within the horn of the petal; it is they which look like the bee's body: Ranunculus has nothing of this, but five common petals instead. The Larkspur has a great many stamens arising from below the carpels; this is the *first essential* character of Ranunculus; it has also several carpels (two or three) which are not grown together: and this is the *second essential* character of Ranunculus; so that this plant has, in reality, no essential character by which it can be distinguished from the Crowfoot tribe. As for its four strange petals, they are of no importance; for you will remark that in Trollius, the petals are little hollow bodies, and that the Marsh Marigold has none whatever; so that not only the form of the petals is of no consequence in the Crowfoot tribe, but it does not even signify whether they are present at all or not.

When you have once satisfied yourself that the

Larkspur belongs to Ranunculaceæ, you will have no difficulty in perceiving that the true *Aconite* (Aconitum), is also of the same natural order; for the resemblance of these two is too striking to be mistaken. The true Aconite, which yields to no plant in the virulent poison of its roots, has all the structure of the Larkspur, except that the upper leaf of its calyx has not any horn, but is very large, and resembles a sort of helmet, overshadowing all the other parts of the flower. In consequence of there being no horn to the upper leaf of the calyx, the two uppermost petals, which have horns, are forced to hide them beneath the helmet, instead of inserting them into it. With these differences the Larkspur and the true Aconite are formed nearly alike.

Pæonies are the last plants I need mention, as belonging to the Crowfoot tribe. They have a calyx which resembles green leaves, and which never drops off; in other Ranunculaceæ, the calyx often drops off, even before the petals; in this respect, Pæonies are unlike the rest of the Crowfoot tribe; but they have the two essential marks of distinction in the carpels and the stamens.

Let me recommend you to procure, if possible, all the plants that have thus been enumerated, and to compare them with one another till you fully understand their resemblance, which you may very readily do; and then you will find, that to know the structure of the common Crowfoot, is, indeed, as I said in the beginning, to know the properties and general character of a large natural order.

The next plants I would advise you to study, are the *Poppies;* that singular genus, which, in the form of a few red flowered species, is the plague of the careless farmer, who calls them Redweed, and, in the form of another, is rendered, by the folly and vice of man, the scourge of half the world, in the shape of opium. The Poppies form a genus of plants representing the characters of a small natural order, very nearly related to the Crowfoot tribe, from which it differs in its properties, being of a stupifying, instead of a burning and blistering nature, as well as in its botanical characters. Like the Crowfoot, the Poppy has leaves with netted veins, and also a great many stamens, arising from under the carpels; but, unlike the Crowfoot, the carpels are not several, and distinct from each other, but have all grown together into a single ovary (Pl. I. 2. *fig.* 2.); the styles are wanting; and the stigmas are elevated hairy lines, which spread equally from the top of the ovary, forming a sort of star-like crown. If you open the ovary, you will find that it consists of but one cell, or cavity; and that several little plates, which project from the sides of it into the cavity (*fig.* 6.), are covered with very numerous and very small ovules, or young seeds. In course of time, the ovary changes to a hollow box, with a hard brittle shell, called a CAPSULE, which is the fruit: and when it has become of a pale brownish colour, it, and the seeds it contains, are ripe; in this state it is the poppy-head you see in the windows of druggists' shops. So hard is the shell of the capsule, and so

small are the seeds, that the latter would never be able to get out unless nature had contrived some certain manner of opening the box. Lid it has none, for the hardened stigmas bind down the top and prevent its opening: but in order to remove this impediment, a number of little valves open underneath the edges of the stigma (*fig.* 5. *a.*), and through these the seeds fall out.

You see then, that the Poppy differs from the Ranunculus, in having the carpels united into an undivided ovary, instead of being all separate; in the same way all the Poppy tribe differ from all the Crowfoot tribe; but this is not all. If you break the stem or leaf of a poppy, there runs out a milky fluid, in which the stupifying principle of the plant is contained; no milk is found in the Crowfoot tribe, the juice of which is always watery and transparent. This is another and most important mark of distinction.

The most essential differences between the Crowfoot tribe, and the Poppy tribe, therefore, stand thus:—

Crowfoot Tribe, or Ranunculaceæ.

Stamens very numerous. Carpels distinct. Juice watery.

Poppy Tribe, or Papaveraceæ.

Stamens very numerous. Carpels united into one central ovary, with a single cavity. Juice milky.

Besides these marks, by which you may know the two natural orders, there are others. The Poppy has two sepals, and twice two petals; this is never

found in the Crowfoot tribe; but as some of the Poppy tribe have three sepals, and twice three petals, the number of those parts is not sufficiently constant to form an essential mark.

Having thus examined the flowers, and ascertained what the differences and resemblances are between the one tribe and the other, I would next advise you to compare the leaves of wild Poppies with those of the Crowfoots, and you cannot fail to be struck with their great resemblance; and thus will you have become acquainted with two striking natural orders, neither of which will you ever be likely, I should hope, to forget.

For the sake, however, of impressing the characters of the Poppy tribe more strongly upon your mind, I should advise you to take a few more examples; especially as the fruit by which the Poppy tribe is partly known, frequently seems, until it has been carefully explained, to be very unlike the only instance we have, as yet, examined.

On the sea-shore near Brighton, and indeed on most parts of the English coast, there grows a blue-leaved plant, which looks as if the salt of the sea spray had encrusted itself upon its skin; but which is sure to be remarked when in flower, because of its large bright yellow flowers, and when in fruit by the long stiff horns it bears in the place of a poppy head; for this last reason it is called *the Horned Poppy* (Glaucium). This plant also belongs to the Poppy tribe. It differs from the Poppy itself, in its fruit being very long and slender, instead of short and

round; but like that plant it contains only one cavity. The reason why the poppy head is so thick, is, that it is formed out of as many carpels grown together, as there are stigmas; in the naked-stalked Poppy there are seven; in the Opium Poppy (Papaver somniferum) there are a great many; in others more and in others less: but in the Horned Poppy the fruit is formed of only two carpels grown together, which will at once explain why the fruit is so narrow.

Celandine (Chelidonium majus), a pale green cut-leaved plant, with little yellow flowers, found in groves and in shady lanes, or in churchyards, by no means uncommonly, is another plant belonging to the Poppy tribe. Its milk is of an orange colour, and has a nauseous taste; its fruit is a long pod constructed like that of the Horned Poppy, but when it is ripe dropping into two pieces called VALVES.

The Argemone or *Prickly Poppy*, and the Eschscholtzia, so very remarkable for its finely cut bluish leaves, and bright yellow flowers, are also of this natural order. In the Eschscholtzia a circumstance happens which you should not omit to note, because it seems to explain in other plants several things which appear at first sight very puzzling. The flower of this species before it expands is enclosed in a taper-pointed green sheath, shaped like a hutkin, which is pushed off by degrees as the petals unfold, and at last drops to the ground. What is this singular part, which is so unlike any thing in the plants hitherto examined? it is the calyx, which, like that

of the Poppy is formed of two sepals; these sepals grow so firmly together by their edges, where they touch each other, that when the time for them to fall off arrives, they are unable to separate; but as it is absolutely indispensable to the plant that the calyx should in some way or other be got rid of, in order to enable the flower to expand, nature has provided the calyx with the means of separating from the stalk by its base; and thus it is pushed off in the manner I have mentioned. This, which is the first instance you have yet seen, of two parts that stand next to each other having grown together, is an exceedingly common occurrence in plants, and is one of the means by which the real nature of flowers is frequently so masqued that one can hardly discover how it is they are formed. I would advise you to recollect this occurrence, and in good time you will see how it explains other things.

This letter will have found occupation enough for your little girls in beginning their Botany, without my carrying the subject further for the present.

EXPLANATION OF PLATE I.

1. THE CROWFOOT TRIBE.—A. A twig of the upper part of the stem of the *Upright Meadow Crowfoot; a a* bracts, *b* calyx.—1. A petal seen in the inside with the scale at the base.—2* An anther with a part of the filament seen in front; 2** the same more magnified, viewed sidewise.—3. The centre of a flower cut through, the calyx and corolla being removed; the stamens are seen spreading outwards, with their filaments originating from underneath the

carpels; the latter occupy the centre, and are shewn to arise from a short conical central part, which is their receptacle.—4. One of the carpels; *a* the ovarium; *b* the style; *c* the stigma.—5. The same carpel cut open so as to shew the young seed, or ovule, *d*.—6. A cluster of ripe carpels, or grains.—7. One of the grains separate; compare this with fig. 4, on the opposite side of the plate.—8. The same grain cut in half, shewing *a* the young plant or embryo, and *b* albumen or nutritive matter stored up for feeding the young plant when it begins to grow.—9. Is an embryo extracted from the albumen and seen from the back.—10. The same seen from the side, so as to shew the two minute seed-leaves or cotyledons, *a*. (N.B. The principal part of these figures is more or less magnified.)

2. The Poppy Tribe.—A. A flower and leaf of the *naked-stemmed Poppy*, the flower of which is turned so as to exhibit the four petals, the stamens, and the ovary; the natural size.—1. Is a flower-bud, with the two sepals by which it is covered.—2. An ovary, with its diverging star-like stigmas.—3. The same part cut through from top to bottom, with the ovules or young seeds exposed.—4. A stamen, with the filament and anther.—5. A capsule, or head, when ripe; the little valves by which the seeds fall out are seen at *a*.—6. The capsule cut across, so as to shew the plates which project from its shell into the cavity, and the multitude of seeds that grow upon the plates.—7. A seed.—8. The same cut through; *a* the albumen; *b* the young plant, or embryo.

The Umbelliferous Tribe.

II. 1.

Fools Parsley.

The Geranium Tribe.

II. 2.

Meadow Geranium.

LETTER II.

THE UMBELLIFEROUS TRIBE—BLANCHING—THE GERANIUM TRIBE—SPIRAL VESSELS—HYBRID PLANTS.

(Plate II.)

You ask me whether the Strawberry is not a plant of the Crowfoot tribe; and if so, how it happens that it is so wholesome a fruit. It is true that the Strawberry plant has, in many respects, a resemblance to the Crowfoot, especially in its numerous stamens and carpels; and I, therefore, am not surprised at your thinking that they must both belong to the same natural order. But when you are more accustomed to the making accurate observations, you will cease to be deceived by such resemblances. On a future occasion I shall introduce the Strawberry and its relations to your notice (see Letter VIII.); for the present I shall content myself with calling your attention to a difference by which they may be readily distinguished. The Crowfoot is, as you have seen, a plant with the stamens *arising from underneath the carpels*, so that when the calyx drops, or is taken off, the stamens still remain surrounding the carpels, and are, as Botanists say, hypogynous (see p. 14.). But in the Strawberry flower you cannot tear off the calyx, without bringing the stamens

away along with it; the stamens therefore *arise out of the calyx*, which is a very different affair from what occurs in the Crowfoot, and in this way they, and the natural orders to which they respectively belong, may be certainly known from each other. When stamens have such an origin as in the Strawberry, they are technically called *perigynous*, a term which is so commonly used, that I could wish you to remember it.

Let me now shew you a natural order of plants, which, although less beautiful than the Poppy tribe and the Crowfoot tribe, is not less interesting or important. Enclosed with this letter are fresh gathered specimens of a little plant with dark-green leaves, cut into many fine divisions, like parsley-leaves; their smell is strong and unpleasant. The flower-stem of this weed is about a foot high, and it bears small greenish-white blossoms, arranged at the ends of the branches in a very peculiar manner (Pl. II. 1. *fig.* 1.). From its resemblance to Parsley, and from its noxious qualities, for it is very poisonous, the vulgar call it *Fool's Parsley* (Æthusa Cynapium). You will find it growing wild in almost any piece of waste garden ground, where it has sometimes been mistaken for Parsley that has sprung up spontaneously, and has proved fatal to unfortunate children who have eaten of its leaves.

As it is rather a dangerous neighbour, you will not be sorry that I have taken an early opportunity of shewing you how to know the traitor, notwithstanding his resemblance to one of the most harmless

of plants. Look at the way in which the flowers are arranged. You will remark that the flower-stem divides at the top into a number of short slender branches, which all proceed from a common point, just as the rays of a parasol all proceed from the ring which slides up the stick; this is called an UMBEL. Each of these rays is terminated by a cluster of flowers, the stalks of which also proceed from a common point, and form again an umbel. So that the Fool's Parsley not only has its flowers arranged in umbels, but in what, in consequence of their divided nature, are called *compound* umbels; the clusters of flower-stalks by which the branches of the first set of rays are terminated, are called *simple* umbels, by way of distinction. It is to this circumstance of the peculiar arrangement of the flowers, that the natural order to which the Fool's Parsley belongs is called *Umbelliferous*, or Umbel-bearers; for all the other plants belonging to the order, have their flowers arranged in a similar manner; and thus you have one exceedingly simple and manifest character by which the order is known.

Let us next look at a separate flower; the parts are very small, but your little people's eyes are, I dare say, good enough for them to see all that I think it necessary to point out, without the use of a microscope. In the first place, there is scarcely any sign of a calyx; all that you can find is a little narrow border, from within which the petals arise. The petals are five in number (*fig.* 2.), of a greenish-white colour, and each has its point doubled inwards

(*fig.* 3.), in such a way as to look like the spots in a suit of hearts in playing-cards; there are only five stamens, and they arise from between the petals. The centre of the little flower is occupied by a whitish fleshy body, which is divided into two lobes, from the top of each of which springs a style (*fig.* 5.). Where now is the ovary? Is it the whitish fleshy body from out of which the styles arise? if so, young seeds must be found in the inside of that part; but if you cut it, you will find neither cavity nor young seed.

The ovary is in this plant so concealed, that a beginner would not be likely to find it without assistance. Look at the top of the flower-stalk, on the outside of the petals; you will find a thickish deep-green furrowed part (*fig.* 5. *a.*), from the top of which the petals and stamens spring; and if you cut that part across you will discern two little cavities, in each of which hangs a young seed. This then is the ovary, which in Umbelliferous plants seems placed below the calyx and the corolla, on which account it is called *inferior*, just as in the Crowfoot and Poppy tribes, in which it stands above the calyx and corolla, it is termed *superior*.

These terms, like many others used in Botanical books, were invented long since, when Botany was in a rude state, and they convey an incorrect notion of the true nature of the parts to which they are applied. I shall, therefore, digress a little, to explain to you the real nature of the difference between a superior and an inferior ovary. In plants, such as the Crowfoot, which have a superior ovary, the

sepals, the petals, the stamens, and the pistils, grow *separate* from each other; but in umbelliferous plants, whose ovary is inferior, the principal part of the calyx, the stalks of the petals, and the lower half of the filaments, grow to the sides of the ovary so firmly that they cannot be separated, and hence the ovary looks as if it grew beneath the other parts; while, in reality, the parts of the flower, both of the Crowfoot and Fool's Parsley spring from the top of the flower-stalk, beneath the pistil; but in the former, they are all separate; while in the latter, they grow all together.

After the petals and stamens have fallen off, the ovary gradually increases in size; the furrows on its surface become deeper; it hardens, acquires a dull brown colour, and, at last, a fruit (*fig.* 6.) is formed, which, in time, separates into two halves (*fig.* 7. *a. b.*), or grains; which are what are vulgarly and inaccurately named seeds.

These are the principal peculiarities in the flowers of umbelliferous plants; and they will always serve to know them by. You may, if you wish it, render their characters more simple and more easy to remember, by taking the essential distinction of umbelliferous plants to consist in *flowers growing in umbels, and inferior fruit, which when ripe separates, or may be separated, into two grains.* The appearance of this order is, however, so peculiar, that I have no fear of its being recognised with certainty after you have seen a few more instances of it.

Let us now return to the means of distinguishing

Fool's Parsley from common Parsley. Observe, once more, the simple umbels of the former species; at the bottom of the flower-stalks there are a few narrow taper-pointed green leaves which you will, probably, recognize by their situations to be bracts (see page 5. and *fig.* 1. *a. a. a.*). When bracts surround a number of flowers in a ring, just as sepals surround petals, and petals surround stamens, they form what is called an INVOLUCRE; it is, therefore, by this name that I must speak of the bracts of umbelliferous plants. The involucres, then, of Fool's Parsley, consist each of three leaves, which all turn one way, spreading towards the outside of the umbel; by this easy character it may be certainly known from common Parsley, and from all the rest of our wild umbelliferous plants, the involucres of which are quite different.

It would be a good thing if they could all be distinguished from each other as easily; but, unfortunately, umbelliferous plants are often so much alike, that nothing but a very minute attention to the formation of the fruit, will enable you to find out their names and qualities with certainty. I shall not pretend to shew you much of the manner of doing this; for, if you would learn to distinguish them, you must peruse books on systematic Botany, in which umbelliferous plants are described. But, as it will be useful for you to know the meaning of some words that are, of necessity, employed in speaking of their fruit, I may as well explain what those are.

The back of each half of the fruit of Fool's Parsley,

has four deep *furrows* (valleculæ) which cause five elevated *ridges* to appear (*fig.* 10. *a.*); the nature of these furrows and ridges is very much attended to. The faces of the halves of the fruit, where they touched each other before they were separated, are also noticed; they are called the *commissure.* In the skin of the seed, underneath the rind of the fruit, you will often see very minute slender brown lines (*fig.* 10. and 9. *b.*), which, if highly magnified, are found to be bags filled with oil; they are called stripes, or *vittæ*, and it is in them that the substance which gives so pleasant a flavour to caraways and coriander grains, is stored up. You may, perhaps, have a difficulty in finding the stripes; if so, cut a ripe grain across (*fig.* 10.), and you will see the ends of the stripes (*fig.* 10. *b.*) looking like little mouths, out of which a dark oily matter slightly oozes; or if you are still unsuccessful in your search, then make a thin slice in the same direction, place it in water under the microscope, and throw light upon it from beneath, by means of the mirror, and the ends of the stripes will appear as so many holes.

There are few tribes of plants more familiar to us than the umbelliferous, because of the many useful species that it contains. The carrot, the parsnep, celery, eryngo, angelica, lovage, caraway, coriander, dill, anise, hemlock, fennel, and samphire, are all well known kinds; besides which there is a host of others with which the Botanist is acquainted. I should advise you to desire the gardener to find you specimens of all those I have mentioned, and,

on learning the distinctions of them, to compare them with each other, and with the descriptions of Botanists, before you attempt to attend to the wild species; in that way you will familiarise yourself a little with the manner in which the characters are drawn up; a very necessary qualification for every one who would study umbelliferous plants like a Botanist.

The greater part of the species has white or whitish flowers: a good many, as the fennel for example, have yellow flowers, and a very few blue ones. To the latter class belong most of the species of Eryngo, and the beautiful Didiscus cœruleus (*Bot. Register*, *fig.* 1225.), which, although a native of New Holland, forms so charming a hardy ornament of the flower garden in the summer.

It is not a common circumstance for a tribe so very similar in the structure of the species as umbelliferous plants, to contain both poisonous and wholesome kinds; but here we have the Deadly Hemlock and Dropwort, associated with Parsley, Carrots and Fennel; and what seems still more remarkable, a species, Celery, which is unwholesome in its wild state, become harmless when cultivated. Common Celery is a native of the meadows of many parts of England, where it forms a rank weedy strong-smelling herb, which is unfit for human food; how different it is in gardens every body knows. It is thought that its ceasing to be noxious when cultivated is owing to the greater part of its stems and leaves being blanched. No doubt you must be

curious to know why blanching a plant should destroy its unwholesomeness, and therefore we will again digress from our principal subject for the purpose of explaining this curious fact.

In my last letter, I told you that the business of leaves is to expose to light and air the sap they suck out of the stem. The consequence of light and air acting upon the surface of leaves, is the forming in their substance, which is originally of the same yellowish-white that you see in seeds, a green colour, which is more or less deep in proportion to the degree in which the light is powerful; thus a plant which stands exposed to the sun all day long, has its leaves of a darker green than another which grows among other trees, or near a building which throws it into the shade for a part of the day: and the latter again is darker green than a plant which grows at the north side of a high wall, or in an enclosed court which the sun's rays never enter. In like manner, if you cause a plant or any part of a plant to grow in total darkness, it will be entirely destitute of greenness; or in other words, the substance of the plant will remain of its original yellowish-white, because no green matter can be formed but by the action of light; and if a part already green is kept for a long time in darkness, it will become yellowish-white, in consequence of all its green being destroyed by the peculiar action of the atmosphere upon plants in darkness.—This is the explanation of blanching. But mere loss of colour is not the only consequence of plants being kept in the dark;

you have already been told that poisons, when it is the nature of plants to yield poisons, are also formed in leaves by the action of light; the absence of this wonderful agent will therefore prevent the formation of poison, as well as the formation of green colour; and hence blanching renders poisonous plants harmless. Thus, in the Celery, but a small portion only of the leaves is exposed to light; the whole of the stem and of the lower part of the leaves is buried in the earth; the small quantity of noxious matter that might be formed by the few leaves which are allowed to bask in the sun, has to pass down the buried stalks of the leaves before it can reach the stem, where it would be laid up; but you know the leaf-stalk of the Celery is very long, and any thing which has to filter from the upper part of such a leaf to its bottom has to take a long journey, in the course of which it is constantly under the destroying influence of darkness; so that before it can reach the stem, it will all have perished. A similar effect is produced by the Italians upon Fennel, which, although not a poisonous plant, has too powerful a taste to be a pleasant food, except as an ingredient for flavouring sauces. The Italians, in their warm climate, cause Fennel to grow rapidly in darkness, and thus obtain it in a state very like Celery in appearance; the darkness destroys the principal part of the flavour, no more of the Fennel taste being left than is sufficient to give the blanched stems a pleasant aromatic quality,

There are no plants which you are likely to mis-

take for umbelliferous, if you will only attend to the exact nature of the characters I have already explained. Nevertheless, as it is exceedingly difficult for beginners to comprehend the necessity of exactness in natural history, and as you have already been puzzled about the Strawberry and the Crowfoot, I may as well caution you against an error which you may fall into; and I cannot do better than point it out in the words of Rousseau himself. "If you should happen, after reading my letter, to walk out and find an Elder-bush in flower, I am almost sure that at first sight you would exclaim; here we have an umbelliferous plant. You would find a large umbel, a small umbel, little white blossoms, an inferior ovary, and five stamens; yes, it must be an umbelliferous plant. But let us look again; suppose I take a flower. In the first place, instead of five petals, I find a corolla, with five divisions, it is true, but nevertheless with all five joined into one piece; now flowers of umbelliferous plants are not so constructed. Here indeed are five stamens, but I see no styles: I see three stigmas more often than two; and three grains more often than two; but umbelliferous plants have never either more or less than two stigmas, nor more nor less than two grains to each flower. Besides, the fruit of the Elder is a juicy berry, while that of umbelliferous plants is dry and hard. The Elder, therefore, is not an umbelliferous plant. If you now go back a little, and look more attentively at the way in which the flowers are disposed, you will also find their arrangement

only in appearance like that of umbelliferous plants: The first rays, instead of setting off exactly from the same centre, arise some a little higher, and some a little lower; the little rays originate with still less regularity; there is nothing like the invariable order you find in umbelliferous plants. In fact, the arrangement of the flowers of the Elder is in a *cyme*, and not in an umbel. See how mistakes will sometimes lead us to the discovery of truth."

You must not suppose from so much having been said about the umbel, that that kind of arrangement of flowers, always indicates an umbelliferous plant; on the contrary it is only when the umbels bear inferior fruits separating into two grains that they really belong to plants of this natural order. There are many other plants which bear umbels, with a different structure of the flower, as for instance the *Geranium tribe* (Plate II. 2.). Many species of that natural order have simple umbels, but the structure of their flowers is exceedingly different. Suppose I fill up my letter with some account of them; if you are weary of study for the moment, you can leave off at the point at which we have now arrived, and resume the subject on another day.

Do you know what a *Geranium* is? if you ask the gardener for one, he will bring you a neat-looking shrubby green-house plant, with fragrant leaves and upright umbels of beautiful red flowers; this however is not a Geranium, although it is nearly related to one, and belongs to the Geranium tribe; it is a Pelargonium. The real Geraniums are little herbs which

grow by the way side, or in waste places, or in the meadows, and some of which are often cultivated in the borders of the flower-garden or shrubbery, for the sake of their gay red or white or purple blossoms. One of them, the Meadow Geranium, is so very common that you can scarcely fail to procure it; if you should fail, then almost any other kind will do as well for the purpose of enabling you to follow me.

This plant has roundish leaves, divided into several deep lobes, with the veins branching in the manner of Exogenous plants (p. 13.), a circumstance which also occurred in the umbelliferous order, although I forgot to mention it. The leaves are placed upon long hairy stalks which are singularly swollen at the base, where there grows a pair of pale thin green scales called STIPULES; these parts you have not before seen; they are frequently not met with in any species of a whole natural order, but when they do occur they usually accompany the leaves of every plant in the order; their use is unknown. The flowers of this species can hardly be said to be in an umbel, for only two of them grow together, but if more were to appear, as is the case in other species, they would all diverge from one common centre; and this you know would make an umbel. Their calyx consists of five ribbed sepals which spread when the flower is open, and when the petals have fallen off contract round the young and tender ovaries, to which they form an efficient protection. The petals are five, of a purplish blue colour; they are very round at their ends, and spread in such a manner as to form a

figure something resembling a saucer; their veins are unusually prominent, and give the petals a streaked or pencilled appearance.

We did not see any veins in the petals of the Crowfoots, or the Poppies, or the Umbelliferous plants, and yet we might have found them if we had paid attention, for veins are as regularly found in petals as in leaves, and, what is very curious, they have the same structure, except that they are usually composed of air-vessels only. The tough and flexible tubes, or water-pipes, which you find surrounding the air-vessels in the veins of leaves (p. 12.), are in those organs indispensable for the protection of the air-vessels, and for giving strength to the leaf, during the many months which it has to exist; but all this wonderful provision against injury, would be thrown away in the petals, which never live beyond a few days, sometimes only a few hours; and would be prejudicial to that delicate and transparent appearance in them which we so much admire. Nature, therefore, who creates nothing in vain, has generally formed petals with veins composed of air-vessels only; and hence the extreme delicacy of the fragile corolla. The petals of the Geranium are so well adapted to shew you this arrangement, and you must be so curious to witness the way in which the secret workings of vegetation take place, that I am sure you will thank me for teaching you how you can best view the structure. For this purpose place the petal of a Geranium upon a piece of perfectly smooth and flat glass, such as is usually furnished for the transparent stage of a

microscope; wet it with water; and then lay over it another flat piece of glass. Press the two glasses firmly together, and by degrees you will squeeze all the air out of the petal, and it will become transparent. You may then, with a pretty good magnifying power, observe all the air-vessels of the veins distinctly, looking like fine threads of silver wire twisted up like a spiral spring. It is on account of this appearance that the air-vessels are called technically SPIRAL VESSELS.

The stamens (*fig.* 2.) are ten, arising from beneath the pistil; that is, they are hypogynous; they are placed in two rows, each of which consists of five stamens. The lower part of the filament is broad, and rather convex; it curves a little towards the pistil, and then tapers off into the part which bears the anther.

The pistil (*fig.* 3.) has a very singular appearance. At the base it has five roundish projections, covered all over with clammy hairs; from the top of these projections a sort of column arises, which at the point is five-lobed (*fig.* 4.); the projections are the ovaries, the column is composed of five styles glued together, and the five lobes are the stigmas. The hairs upon the ovaries will give you a good idea of the nature of hairs in other plants. Cut off, with a sharp knife, a very minute portion of the skin of one of the ovaries, and lay the morsel on its side in water under the microscope; you will find that the hairs are delicate transparent projections, tapering to a point. Some of them are very short and

curved downwards, as if it was their business to protect the surface of the ovary (*fig.* 11.), others stand erect, and have a head of a brownish colour, from which a clammy fluid exudes; the last are secreting hairs, and their duty is supposed to consist in carrying off the volatile matter to which the plant owes it smell; for they are not only found on the ovaries, but on almost all the other parts.

When the fruit (*fig.* 6.) is ripe, it resembles, in a striking manner, the bill of certain birds; on which account the Geranium is called, in English, Cranes-bill, by which I would have introduced it to you, if the Latin name had not become the more common. This singular appearance is owing to a very simple circumstance. In most plants the styles shrink up, or fall off, at the same time that the flower fades, and by the time the fruit is ripe, have entirely disappeared. But in the Geranium, the styles continue to grow and harden as fast as the fruit itself; and when the latter is ripe, the styles project from the ovaries in the form of a beak. At the time when the fruit is ripe the seeds are shut up in the cavities of the ovary, so that one would wonder how they are to get out; if you would wish to catch the Geranium in the act of sowing its seed, gather a little branch of the ripe fruit in a fine summer's morning, before the dew is off it, and put it in the sun. By degrees the fruits will dry, and if you watch them, you will be surprised by some of them, on a sudden, emitting a snapping sound, and you may see first one and then others of the ovaries

quickly curving upwards towards the top of the style, opening, at the same time, by their face, so as to let their seed drop out (*fig.* 6. *a.*). This is caused by the styles contracting from dryness, and shortening; they stick so close together at their points, that they cannot separate there, and so they actually pull the ovary up by the roots, and then roll up upon themselves, as if they were frightened at what they had done. The seeds are often beautiful objects, and are sometimes curiously pitted, or netted all over their surface. No workman ever gave such finishing to the setting of the most costly gems, as Nature has given even to the seeds of a weed.

Among our wild flowers are two genera which belong to the Geranium tribe; the Geranium itself, and the *Storksbill* (Erodium). The latter is very common, in gravelly and sandy wastes, and looks so like a Geranium, that you will, most likely, mistake it for one. You may, however, know it by five only of its ten stamens bearing anthers. In the Geranium you will find that the five outermost of the stamens, are much shorter than those which form the inner row, and more stunted (*fig.* 2.), but they all have anthers. In the Storksbill the five outer are still more stunted, and have no anthers. But the most interesting part of the tribe is that which is cultivated in green-houses, and to which I have already said the name *Pelargonium* is applied. This differs from both the other genera in the stamens being more than five, and fewer than ten in number, and in the corolla being irregular, that is to say, different in dif-

ferent parts; the two upper petals are larger than the three lower, and stand altogether apart, so as to give the flower the appearance of having two lips. These Pelargoniums are almost entirely natives of the Cape of Good Hope, and have become as much the favourites of modern florists, as the tulip, the pink, the ranunculus, and the auricula were of their forefathers. And yet they were not originally so very beautiful; their leaves indeed were always fragrant and their colours gay, but they possessed nothing like the clearness of complexion, the regular features, and the rich variety of colour which characterise the present race. To what are we to attribute this sudden change? To cultivation? No doubt to cultivation; but to cultivation of a very peculiar kind, of which our ancestors never dreamed; we call it HYBRIDIZING.

You are already acquainted with the singular causes which bring about the change of ovules into seeds (see page 8.); and you know, that if the pollen does not act upon the stigma, the ovules shrivel up and die prematurely. It has been discovered, that if two plants are very near relations, the pollen of one will act upon the stigma of the other, just as well as if the pollen was produced by the anthers of the plant to which the stigma belongs; but when the seeds so obtained are sown, they change to plants which are not exactly like either of those from the intermixture of which they sprang, but which bear a strong resemblance to both. For instance, if you take the pollen of a plant with blue flowers, and place it upon

the stigma of one which has red flowers, the seed will produce a plant having purple flowers; or, if a plant with a very vigorous mode of growth is thus intermixed with another of a very dwarf habit, the plants which spring from seeds thus procured, will be neither very dwarf nor very tall; and so on. This is the secret of the improvement of Pelargoniums, which happen to intermix very easily: a sort with large ugly flowers, is intermixed with one with small neat flowers, and you have, in all probability, a variety with large flowers, that are as neat in appearance as those of the small flowered kind. I need not particularize, with more minuteness, the way in which plants respectively influence each other; a little reflection must render it apparent to you, now that you understand the principle. I must not, however, omit to tell you, that intermixture can only take place between plants very closely related to each other, and that distant relations have no influence the one on the other. You could not hybridize a Geranium with a Pelargonium, nor those Pelargoniums which have fleshy tumours for stems with such as have slender stems, nor even a gooseberry with a currant; but to the power of intermixing the slender stemmed real Pelargoniums there seems to be no limit.

That nature acted thus, long before man discovered her secret, there can be no doubt; for winds and insects are as skilful hybridizers as we are; and the different races of apples, pears, and other fruit, which have, in all ages, sprung up in gardens, are, no doubt, indebted for their origin to such circum-

stances; but it is only in modern times that this mode of proceeding has been reduced within certain rules, and that hybridizing has become a fixed and useful art.

EXPLANATION OF PLATE II.

I. The Umbelliferous Tribe.—1. A portion of the flowering stem of *Fool's Parsley*, shewing the umbel; *a a a* the one-sided involucres by which the plant is especially known.—2. A flower magnified, shewing the petals, stamens, styles, and disk.—3. A petal separated from the rest, with its curious incurved point.—4. A stamen, with the filament and anther.—5. A young ovary seen from the side; *a* the ovary itself; *b* the styles; *c* the line where the calyx is to be sought for.—6. A ripe fruit viewed from its side; at the base, a forked axis is just perceptible, from the arms of which the grains finally swing.—7. The fruit with its grains separated, and swinging from the arms of the axis.—8. A back view of one of the grains; the five prominent ridges are distinctly visible.—9. The face or commissure of the same grain; *b* one of the stripes or vittæ.—10. The same grain cut through; *a* the ridges; *b* the stripes; *c* the albumen.—11. Half a seed taken out of the rind of the grain: *a* the embryo, lying at the upper end of a large quantity of albumen.—12. The embryo very highly magnified, and seen sideways for the sake of shewing its two seed-leaves, or cotyledons.

II. The Geranium Tribe.—1. A couple of flowers of *Meadow Geranium*, one of which has dropped its petals; *a* bracts.—2. The ten stamens and the style.—3. The lower part of a pistil, covered with glandular hairs.—4. The top of the style and the five stigmas.—5. The lower part of a pistil split, to shew *a* the ovule, and *b* a tapering axis, to which the styles are glued. It is this part which forms the hard centre of the beak in the ripe fruit, and from which the styles drop, after they have curled up to shed the seeds.—6. A couple of ripe fruit, one of which is beginning to shed its seed; *a* an ovary from which the seed has dropped.—7. A seed; *a* the

hilum, or scar left by its separating from the ovary.—8. Seed split; the embryo is curiously rolled up, and plaited, and there is no albumen; *a* is the radicle, or seed-root; *b* the cotyledons, or seed-leaves.—9. Is a cross section of the same seed.—10. The embryo in its natural state, with the skin of the seed stripped off; the radicle is a taper body, hooked back at the narrow end of the embryo.—11. Hairs very highly magnified; the short sharp-pointed ones are lymphatic hairs; the long upright pin-headed ones are secreting hairs.

LETTER III.

THE EVENING PRIMROSE TRIBE—THE MYRTLE TRIBE.

(Plate III.)

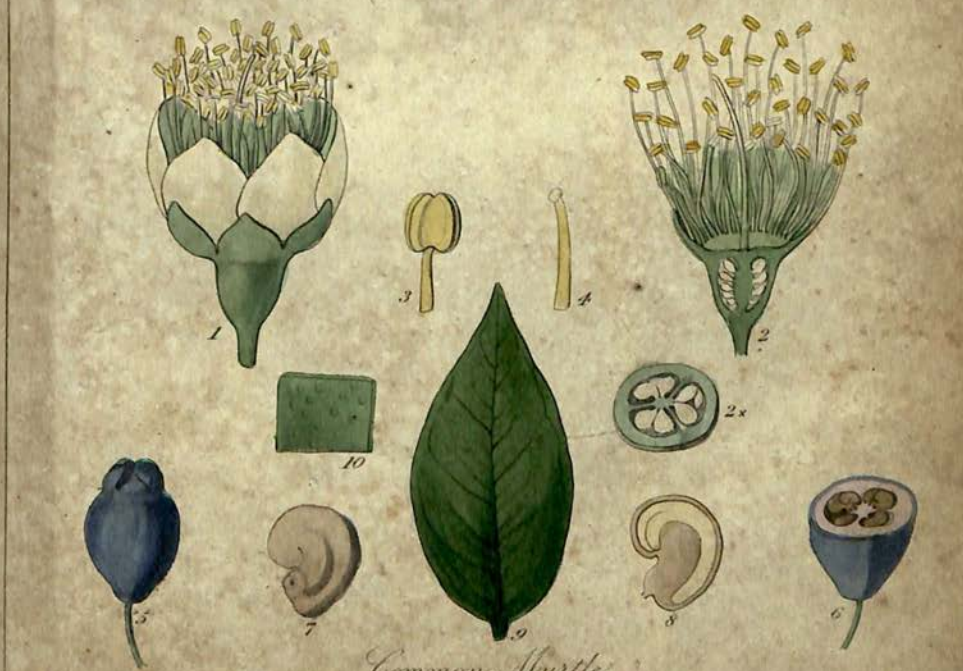
My last letter was so long that I fear you must consider me unreasonable in expecting you to be already prepared for another. And yet I think that considering the interest you say your little girls take in plants, I shall scarcely do wrong in profiting by the present opportunity of going on with the subject, especially as this letter is likely to be much shorter than the last. They already begin to wonder where the terrible difficulties lie concealed, with which you have hitherto been frightened from allowing them to study Botany; but I can venture to assure them that, as far as the elementary parts of the science are concerned, there are no difficulties to encounter greater than what they have already overcome. I feel perfectly sure that Crowfoots, and Poppies, and Umbel-bearing plants, and Geraniums, are now familiar to you, together with all their relations. We will next take a family of quite another kind.

In the meadows and woods of Europe, North America, and the colder parts of Asia, are found a great number of herbs which, with a great accor-

The Evening Primrose Tribe. III. 1.

Shrubby Evening Primrose.

The Myrtle Tribe. III. 2.



Common Myrtle.

dance in their general appearance, agree also in this remarkable circumstance, that every one of the parts of the flower consists either of four pieces or of some number which may be divided by four; in South America are many species of a similar nature, only they are shrubs and are much more richly coloured. Botanists call these Onagraceæ, or the *Evening Primrose tribe*, because the charming yellow flower which unfolds its bosom to the evening sun, and drinks up the dews of night with its petals, rendering darkness as lovely as noon-day, but which retires at the approach of the sun, rolling up its petals and carefully protecting its stamens and pistils from the glare of light, is one of the tribe; it might be called the owl of the vegetable world, only it is more beautiful and delicate than that hard-hearted enemy of mice.

If you have ever examined one of them accurately you will be at no loss to recognize all the rest. For this purpose suppose you take the *Shrubby Evening Primrose* (Œnothera fruticosa), a beautiful little North American plant, with an absurd name, for it is not a shrub.

The leaves of this plant are of a narrow figure, not unlike the head of a lance, and their veins are disposed in a netted manner like all the preceding; it has therefore a stem which increases in size by addition of matter to the outside of the wood; or in a word it is Exogenous; the leaves do not grow *opposite* each other from opposite sides of the stem, but are placed one a little above the other, so as to be *alternate*; mark this.

The flowers are bright yellow; and are entirely different from those of any of the preceding tribes. In the first place the calyx has a long slender tube (Plate III. I. *fig.* 1. *a.*), from the top of which arise two leaves, both turned the same way, and notched at the point (*fig.* 1. *b.*); it is in reality composed of four sepals, united at the base into a tube, but capable of being separated above the tube into *four* pieces, as you may easily see if you attempt to divide it with the point of a pin.

From the top of the tube of the calyx arise *four* petals.—Observe, again,—four,—which are of a bright yellow, and are rolled together, except in the night, when the flowers are expanded.

Twice four stamens spring from the top of the tube; each has a very long anther, which swings by its middle from the summit of the filament, and sheds its pollen in such a way that it looks as if it were mixed with cobweb. If you magnify this pollen in a drop of water, each grain will be found three-cornered (*fig.* 5.), and held to its neighbour by excessively delicate threads; a peculiarity in the pollen which is rarely met with, except in the Evening Primrose tribe.

The ovary (*fig.* 1. *c.*) is inferior, and is marked by eight ribs, of which *four* are more prominent than the others; it contains *four* cavities, in each of which is a great many seeds. The style is a long slender body, rising within the tube of the calyx, as high as the stamens, and then separating into *four* narrow stigmas.

The fruit is a dry oval case, with *four* angles, opening into *four* pieces, called VALVES (*fig.* 6.).

Thus, you see all the parts of this plant, from its calyx to its fruit, consist either of four, or twice four parts; the like happens in all the genuine species of the same natural order; by which character they are easily known. There are many plants of very different orders, that have four sepals, or four petals, or some of their other parts of that number; but it is only in the Evening Primrose tribe that all the parts are in fours at the same time; or some multiple of four, which is botanically the same thing.

There are no Evening Primroses, really wild, in Great Britain, however frequent they may be in gardens. But there is an exceedingly common wild flower, called *Willow-herb* (Epilobium), one of the species of which, called the "great hairy," is, perhaps, the most noble of all our British herbs. Its stout shaggy stems grow five or six feet high, and are terminated by long clusters of bright red flowers. If you were to compare it with the description of the Evening Primrose, you would think it really must be a species of that genus, only the flowers are not yellow. This, however, is not the only difference. When the fruit of the Willow-herb is ripe, it sheds seeds which are furnished with a curious apparatus to enable them to fly about, and spread themselves over the land; each of them has a very long tuft of silk at one end, which is so light, that the smallest breeze is sufficient to buoy it up, and raise it aloft into the air, there to be caught and carried to a great distance.

Nothing of this sort is found in the Evening Primrose.

Another plant, of far greater beauty than either of the foregoing, is the Fuchsia, an American genus, for which no English name has been contrived, and which is now one of the greatest of all the foreign ornaments with which our gardens are embellished in the summer and autumn. Every body has Fuchsias; the poor weaver grows them in his window; many an industrious cottager shews them as the pride of the little plot of ground before his door; and even the suburban inhabitants of London itself, speak of the beautiful Fuchsias they rear, with enthusiasm and delight. You must, therefore, know very well what the Fuchsia plant is. Examine its flowers; on the outside of all, you have a deep crimson covering, divided into four firm sharp-pointed leaves; this is the calyx. Rolled up within it, and closely embracing the stamens, are four little dark purple leaves, which are not half so long as the calyx; they are the petals. The other parts you will easily recognise. But the fruit is not a hard dry case, or capsule, bursting into four valves when it is ripe; it contains four cavities indeed; but its rind is deep purple, fleshy and juicy; in a word, it is a berry. This, then, is a marked distinction from other plants of the Evening Primrose tribe; but, as in all other respects the Fuchsia agrees with them, it is not accounted sufficiently different to belong to any other natural order.

The Evening Primrose tribe has little, except its beauty, to render it interesting to mankind; for

there is not a single species which possesses any useful property worth mentioning. Remember, that number four, throughout all the parts of the flower, is its character; and you will be in no danger of either forgetting it, or mistaking it.

I have already said that other orders have, occasionally, four parts of the calyx, or corolla, or of some other class of organs, and yet do not belong to the Evening Primrose tribe. I will give you an instance of this.

You know what a Myrtle is. Take a sprig of that beautiful, but delicate evergreen, for your next subject. It has hard shining deep-green leaves, which do not drop off when winter comes; but seem as if they were intended to make us forget that winter has power over vegetation; they stand *opposite* each other, and if you bruise them, emit a fragrant aromatic odour. If you hold them against the light, you will see them look as if pierced with holes, closed up by a green transparent substance; they are not, however, pierced: but the appearance is owing to their containing a vast number of little transparent cells, in which the aromatic matter, to which they owe their fragrance, is laid up (Plate III. 1. *fig.* 10.).

The flowers have a calyx of five divisions; there are five petals of a dazzling white; and from the sides of the calyx, there arises, in a ring, a very considerable number of slender white filaments, tipped by little roundish anthers (*fig.* 3.).

The ovary, which is inferior, contains three cells, and a good many ovules; from its flat top springs

one style (*fig.* 2.), which ends in a stigma, so small that it cannot be discovered without a microscope (*fig.* 4.).

The fruit of the Myrtle is a purple berry, so like a Fuchsia berry on the outside that you might mistake the one for the other; but it has only three cells, instead of four, and has a strong aromatic taste, of which the Fuchsia is entirely destitute.

You will, after reading this, ask me, perhaps, with surprise, what resemblance I can discover between the Myrtle and the Evening Primrose tribe; for it seems difficult to select two objects more unlike. I answer thus—although the Myrtle itself is not very like an Evening Primrose, yet there are many of the Myrtle tribe, which, having only four divisions of the calyx, and four petals, might be mistaken for plants belonging to the Evening Primrose tribe, for they have an inferior berry, like that of a Fuchsia; you would however see that the number four could not be traced further than the petals, and consequently, the resemblance would cease with these parts.

The Myrtle tribe, like the last natural order, abounds in beautiful plants; it also contains many that are of great use. The spice you call *Cloves*, consists of the young flower-buds of a tree found in the East Indies (Caryophyllus aromaticus); and *Allspice* is the berries of a West Indian species (Myrtus Pimenta.) The pleasant fruits called the Rose Apple, and the Jamrosade, in the East Indies, are produced by different kinds of Eugenia; Guava Jelly is prepared from the succulent berries of trees of the Myrtle Tribe, found

in the West Indies; and, finally, the Pomegranate is an example of another fruit-bearing kind, which has migrated from Barbary into Europe.

All these are trees with berries for their fruit; and they form the greatest part of the tribe. Others however there are which have dry fruits opening at the top, and containing a great number of very minute seeds; these, the principal part of which are natives of New Holland, have very often also alternate leaves. It is therefore neither to the fruit nor to the position of the leaves upon the stem, that you are to look for the precise character of the Myrtle tribe. *The inferior ovary, the numerous stamens, the single style, and the dotted leaves,* are what you will know it by with most certainty.

To that division of the tribe in which the fruit is dry and many-seeded belong *Melaleuca* and *Metrosideros,* with their long tassels of silken stamens, purple, or yellow, or crimson; and so do the gigantic *Gum Trees* of New Holland (Eucalyptus). These last are remarkable for having no petals; and for their calyx falling off like a lid or extinguisher. I told you, in my first letter, to observe what I said about the curious calyx of Eschscholtzia, which was pushed off by the petals in the form of a hutkin, in consequence of the sepals not being capable of separating in the usual way. So is it with the Eucalyptus; its calyx has all its parts soldered together, as it were, into a hard fleshy lid; when it is time for the stamens to unfold, they push the calyx so forcibly, that it breaks away by its base and drops off, leaving the stamens at liberty to expand as fully as may be necessary.

EXPLANATION OF PLATE III.

1. The Evening Primrose Tribe.—1. A flower of the *Shrubby Evening Primrose* half unfolded ; *a* the tube of the calyx ; *b* the divisions of the calyx ; *c* the ovary.—2. The same flower deprived of its petals, and with its sepals divided from each other, shewing the stamens and stigma.—3. The tube of the calyx cut open ; at the top are seen the bases of the eight stamens that spring out of it.—4. A stamen.—5. A cluster of pollen grains, with the threads by which they are held together ; represented as they are seen when immersed in water.—6. A ripe fruit, with the four openings at the top, through which the seeds escape.—7. The ovary cut through, before it is ripe ; it exhibits the four cells, and the numerous seeds in them.—8. One of the valves of the fruit separated from the others, with the seeds sticking to it.—9. A seed.—10. An embryo, from which the seed-coat has been stripped ; it is not surrounded by albumen, but is protected only by the skin of the seed.

II. The Myrtle Tribe.—1. A flower of the *Common Myrtle*, much magnified.—2. The same cut perpendicularly, shewing two of the cells of the ovary, and the origin of the style and stamens.—2*. A cross section of the same.—3. Another with part of a filament.—4. The tip of the style and stigma.—5. A ripe fruit.—6. The same cut across, with the curved embryo seen lying within it, without any albumen.—9. A leaf.—10. A portion of a leaf magnified, shewing the transparent dots in it.

The Cruciferous Tribe. IV. 1.

Shepherd's Purse.

The Violet Tribe. IV. 2.

Heartsease

LETTER IV.

THE CRUCIFEROUS TRIBE—DOUBLE FLOWERS—THE VIOLET TRIBE—METHOD OF ANALYSIS.

(Plate IV.)

I AM pleased, but not surprised, to find from your last letter, that Botany dees not prove, upon examination, to be either so dry and technical a science as you imagined, or so little related to objects of daily interest, as others had persuaded you. Depend upon this truth, before all others, that knowledge is always useful, and that when we are unable to discover its utility, we have to blame our own short-sightedness, or incapacity, or any other cause, rather than knowledge itself.

Sir John Herschel, in that admirable treatise of his which should be in the hands of every human being who has arrived at an age to be capable of understanding it,—Sir John Herschel has well remarked that, " the question to what practical end and advantage do your researches tend? is one which the speculative philosopher, who loves knowledge for its own sake, and enjoys, as a rational being should enjoy, the mere contemplation of harmonious and mutually dependent truths, can seldom hear without a sense of humiliation. He feels that there is a lofty

and disinterested pleasure in his speculations which ought to exempt them from such questioning; communicating as they do, to his own mind the purest happiness (after the exercise of the benevolent and moral feelings), of which nature is susceptible, and tending to the injury of no one; he might surely allege this as a sufficient and direct reply to those who, having themselves little capacity, and less relish for intellectual pursuits, are constantly repeating upon him this inquiry. But if he can bring himself to descend from this high but fair ground, and justify himself, his pursuits, and his pleasures in the eyes of those around him, he has only to point to the history of all science, where speculations, apparently the most unprofitable, have almost invariably been those from which the greatest practical applications have emanated. What, for instance, could be apparently more unprofitable than the dry speculations of the ancient geometers on the properties of the conic sections, or than the dreams of Kepler (as they would naturally appear to his contemporaries) about the numerical harmonies of the universe. Yet these are the steps by which we have risen to a knowledge of the elliptic motions of the planets, and the law of gravitation, with all its splendid theoretical consequences, and its inestimable practical results. The ridicule attached to '*Swing-swangs*' in Hooke's time did not prevent him from reviving the proposal of the pendulum as a standard of measure, since so admirably wrought into practice by the genius and perseverance of Captain Kater;—nor did that which

Boyle encountered in his researches on the elasticity and pressure of the air, act as any obstacle to the train of discovery which terminated in the steam-engine. The dreams of the alchemists led them on in the path of experiment, and drew attention to the wonders of chemistry, while they brought their advocates (it must be admitted) to merited contempt and ruin. But in this case it was moral dereliction which gave to ridicule a weight and power not necessarily or naturally belonging to it: but among the alchemists were men of superior minds, who reasoned while they worked, and who, not content to grope always in the dark, and blunder on their subject, sought carefully in the observed nature of their agents for guides in their pursuits;—to these we owe the creation of experimental philosophy."

It perhaps would not have been amiss to have begun this correspondence with the quotation I have just made; but I was anxious that a little interest should be awakened in the subject before any thing like a formal defence of its utility should be undertaken by me. If I were disposed to add any Botanical instance of important results arising from apparently trifling causes, it would be easy enough to do so. For instance, the microscopical investigations by Grew of the nature and properties of the little cells and bladders that are found beneath the skin of plants, were the forerunners of all the valuable train of physiological discoveries, by which the productiveness of the soil has been so much increased; the curious but neglected inquiries of Kölreuter into the

possibility of intermixing the races of plants, laid the foundation of modern improvements in the qualities of cultivated species; while the ingenious but derided speculations of Camerarius upon the relation that exists between the properties and structure of species, have put the physician in possession of a power of discovering the hidden uses of plants, the limits to the application of which no one can foresee.

It is mentioned, that in the voyage of Lord Anson round the world, when new and unknown lands were constantly discovered, the dread which his surgeon entertained of the effect of strange herbs was so great that, from fear of poisoning the crew, he would sometimes permit them to use no other kind of fresh vegetable food than grass. At the present day there should be no navy surgeon who would not be able to point out at once, in every place, an abundance of plants, the use of which could not by possibility be attended by any ill effects. You have already seen that the Crowfoot tribe consists of burning and blistering species, that the Poppy tribe produces stupefaction, the Umbelliferous tribe is chiefly aromatic, but not always to be trusted, Geraniums astringent, Evening Primroses insipid, and Myrtles fragrant and aromatic. Another example of the uniform prevalence of peculiar properties in the same tribe or natural order, is afforded by Cruciferous plants.

The healthy stimulating effects of Mustard and Cress, and the nutritive properties of Turnips and Cabbages are well known to every body. These

plants belong to an extensive tribe called Cruciferous, or Cross-bearers, because their four petals are placed in such a way as to resemble in some degree a Maltese cross. Unfortunately for those who have little power of observation, and less patience, their flowers are usually very small; but I am convinced that this circumstance will be far from deterring my young friends from attempting their study; it will rather operate as an incentive to their making themselves acquainted with them.

They are already, I suspect, familiar with a mean-looking weed, called *Shepherd's Purse* (Capsella Bursa pastoris), which is found every where at all seasons of the year, except the severest part of the winter. Its name was given it because it has a number of pouches filled with very small seeds, which you might fancy were fairy coins. Let us look at it botanically.

Its leaves are veined in that netted manner which indicates the Exogenous structure; and consequently you know that if it were ever to form a woody stem, its woody matter would be arranged in concentric circles. The form of the leaves is like that of an ancient arrow head, sitting closely to the stem, and extended downwards at the base into a sharp barb on either side (Plate IV. 1.).

The flowers are arranged regularly upon a central stalk in the form of a *raceme;* and, what is extremely singular, they are uniformly destitute of bracts. This is so unusual a case that I do not remember any other instance in the whole vegetable kingdom in which bracts are so constantly absent; the absence of

these little leaves is hence a mark of the Cruciferous tribe. Observe, I pray you, how very useful it is to be aware of this. Imagine yourself cast away upon a desert island; and there, surrounded by plants of unknown forms and tempting looks, none of which you dare use from fear of their proving poisonous. Among them however you remark a good many of the same kind, one of which is just beginning to bear its tufts of flowers: the blossoms are too young to be examined, but old enough to shew you that they grow without bracts; the leaves you would easily see were those of Exogenous plants, and you would immediately know that this species at least would be not only harmless, but the very best kind of vegetable for you to consume; a salad which might be eaten with the utmost confidence.

But it is not thus alone that Cruciferous plants may be recognised. The structure of their flowers is of a very peculiar kind. The calyx is formed of four little leaves or sepals; within which are four very small white petals, arranged in the manner which I have already stated gave rise to the appellation of Cross-bearers (*fig.* 1.). Within the petals are six stamens (*fig.* 2.), of which two are a very little shorter and more spreading than the other four. To this character no parallel is to be found in any other than Cruciferous plants, and consequently it is a second essential character, by which they are to be known.

The pistil is an oval green body, shaped something like a wedge, on the summit of which is a little cushion of a stigma seated on an exceedingly short

style (*fig.* 2.). If you cut open the ovary you will find (*fig.* 3.) that it contains two cells, in each of which is a number of young seeds or ovules hanging by slender thread-like stalks.

The fruit (*fig.* 6.) becomes a wedge-shaped flat body, composed of three pieces, two of which (*fig.* 6. *a. a.*), the valves, separate from the third (*fig.* 6. *b.*), which is named the *partition* or DISSEPIMENT (*fig.* 8.); it is to the edges of this third piece that the seeds stick by little threads (*fig.* 7.). In the inside of these seeds the embryo is bent double, after a singular fashion (*fig.* 10.), the seed-root being pressed close to the back of the seed-leaves.

This has been rather a wearisome lesson, to one so little accustomed to the use of the microscope, to which you must already have had recourse several times; but you have now the satisfaction of knowing that you possess the secret of recognizing with certainty nearly a thousand species, scattered over the face of the world, all of which are harmless, and many highly useful.

What would the farmer do without Turnips and Rape, which are Cruciferous plants? or the gardener without Cabbages, Sea-Kail, Mustard, Cress, and Radishes? or how could the florist supply the place of his Wall-flowers and Stocks? All these are such common plants, that you can have no difficulty in procuring specimens for examination; you will find that while they are all unlike in trifling circumstances, they agree in having their parts arranged exactly in the same manner as the Shepherd's Purse;

but you will remark a difference in their fruit, of this nature; in some of them, as the Shepherd's Purse itself, the pod is so very short, that there is not much difference between its length and breadth; in others, it is very long and slender, as in the Turnip and Cabbage; to the former of these fruits the name of *Silicle* is given; to the latter, that of *Silique;* and by many Botanists the whole tribe of Cruciferous plants is divided into two portions, of which one is called *Siliculose,* and the other *Siliquose.* By the more scientific Botanist of the present day, this distinction is held in less estimation, and new divisions, founded upon the structure of the embryo, are employed; but these are so obscure, that I will not fatigue you with them.

The most beautiful species in the whole tribe are the Wall-flower, which sheds its sweetest odours over the ruined buildings of England, and the Stock, that, with its hoary leaves and gay flowers, gives an air of green old age to the rocks and cliffs of the Mediterranean. Both these, however lovely in their wild and single state, are chiefly cultivated when their flowers have become what is called double; that is to say, when the parts which are usually stamens, and pistils, and sepals, are all transformed into petals; by which means the quantity of gaily coloured parts is much augmented. There are those who, with an air of scientific delicacy, pretend to despise these beautiful objects, and call them monsters; but I would not have you follow such an example; for, in reality, double flowers, indepen-

dently of their acknowledged beauty, afford the most important evidence of the true nature of the different parts of the floral system, as you may one day know. To you, as to many others, it may be a subject of wonder how these double flowers are increased, for if the stamens and pistils are converted into petals, it would seem that no means are left for multiplying the race. This would, doubtless, be so, if all the stamens and pistils were really thus transformed; but among many flowers, some are found in which a perfect stamen or two remain; and others, in which a perfect pistil or two can be found. If the stigmas of the latter are touched with the pollen of the former, ovules are fertilized, and seeds produced, which will grow into other plants, the flowers of which will be as double as those of their parents. No one knows why double flowers should be capable of being thus perpetuated; it seems as if any tendency which is once given to a plant, may be carried on from generation to generation, by a careful attention to the stoppage of all disposition to depart from the new character: in the Stock any plant that produces flowers less double than usual, must have a tendency to depart from the double state, and, therefore, should not be allowed to bear seed, or to influence the seeds borne by other plants, but should be carefully eradicated as soon as its flowers are sufficiently expanded for their true character to be ascertained. By attention to such rules, Turnip-rooted and Long-rooted, White, and Scarlet, and Purple Radishes, and all the different races of Turnips, have been pre-

served for years; whereas, if great precautions to maintain them in their purity had not been constantly taken, they would long since have become thrown together, and reconverted into the wild form from which they sprang. I take it for granted, you are so much interested in the pretty flowers of your garden, that you would be sorry to see all the double ones turn single;—you will now be able to avert such a sad catastrophe.

Candy tuft (Iberis), sweet *Alyssum*, the snowy *Arabis* of spring, that pretty little tufted purple thing which is named after the French flower-painter Aubriet (Aubrietia deltoidea), *Honesty* with its clusters of broad bucklers, the modest *Whitlow-grass* (Erophila verna), which springs up on the crest of every wall, the earliest harbinger of spring, *Watercresses*, *Horse Radish*, and a host of others, will be furnished either by the garden, or the fields, to augment your acquaintance with this natural order. Leaving it now, as requiring no further explanation, we will next proceed to another spring tribe.

Violets, sweet Violets, and Pansies or *Heartsease*, represent a small family (Pl. IV. 2.), with the structure of which you should be familiar; more, however, for the sake of its singularity, than for its extent or importance; for the family is a very small one, and there are but few species belonging to it in which much interest is taken. As the parts of the Heartsease are larger than those of the Violet, let us select the former in preference, for the subject of our study.

The Heartsease is a little herbaceous plant, as you

know, with leaves cut, as you suppose, into several deep divisions; here, however, you are mistaken. The true leaf is a narrow oblong blade, with netted veins, rather notched at its edge, and tapering gradually into a stalk (*fig. A. a.*); it is not slashed or divided at all. But on each side of the leaf, quite at the bottom of its stalk, there is a deeply-cut stalkless part, which is of the same colour as the leaf, but shorter (*fig. A. b. b.*); this is a stipule (see page 37), and it is that which gives the lobed and lacerated appearance to the leaf. Here you have an exemplification of the care with which you ought to look at plants if you would understand their construction rightly; it may be true indeed, as theoretical Botanists say, that stipules are only little leaves, but it does not follow that on that account we may call them leaves; for it is quite clear that whatever their theoretical similarity may be, they are stationed by nature in a particular place, in a particular form, for some good purpose or other. You will some day know that the sepals of the calyx, and the petals of the corolla, and the stamens, and the carpels, are all leaves in different states; but you must not on that account cease to distinguish them carefully, and call them by their right names, when you find them fixed by nature in the form of sepals, petals, stamens and carpels. Our own foot is a sort of hand, and our toes are fingers; but we cannot on that account dispense in practice with the use of the words feet and toes.

The flowers consist of five sepals of a narrow

figure and extended in a singular manner at the base; of these some are much larger than the others.

The corolla is formed of five petals, which are also of unequal size; two of them, which are differently coloured, stand erect and rather above the others; a third, standing in front of the rest, has a short horn or spur at its base.

Then we have the stamens, also five in number, of a singularly irregular form (*fig.* 1.); two of them, which are in front of the others, have long tails, which are hidden within the horn of the front petal; the other three have no tail, nor any particular irregularity of figure, but they are all terminated by a broad membrane of a rounded form (*figs.* 2. 3. *a. a.*), and bordered by a fringe of hairs; filaments there are none.

The pistil is a superior roundish pale-green body (*fig.* 5.), terminated by a short fleshy style, which is shaped like a narrow funnel, or a taper inverted cone; at the top (*figs.* 7. 8.) it is of a bright green, nearly spherical, slightly hairy, and hollow, with a hole on one side, to which there is a minute lip; through this hole there is access to the stigma; no one has yet discovered for what purpose such a singular conformation has been provided. The ovary contains but one cell; but, as in the Poppies, it has three projecting lines running up its shell at equal distances in the inside, and covered with young seeds (*fig.* 6.).

When the fruit is ripe it is still surrounded by the calyx (*fig.* 9.), although both petals and stamens have

dropped off; it is an oblong-shining case, which splits into three pieces or valves, in the middle of each of which stick the pale chesnut-coloured shining seeds.

There is no material difference from this structure in such other plants of the Violet tribe as you are ever likely to meet with; and therefore I shall suppose that the whole may be recognized by the characters I have explained.

Beautiful as they all are to look at, they would produce anything rather than Heart's ease if you were to eat them: for their roots have the property of producing sickness in so powerful a manner that they are sometimes used in medicine as emetics. I would therefore advise you to confine your admiration to their beauty or their fragrance.

The Sweet Violet will have no rival among flowers, if we merely seek for delicate fragrance, but her sister, the Heartsease, who is destitute of all sweetness, far surpasses her in rich dresses and gaudy colours. She has become of late a special favourite with florists, who cultivate I know not how many distinct varieties, some of which have flowers of yellow and purple, or all yellow, or all purple, or nearly white, with every gradation of tint and depth, which one can well imagine. Methinks, I hear my young friends exclaim, are these fine plants, indeed, our humble Pansy, changed by cultivation? is it possible that the little drooping weed, which we have so often gathered among the stubble of cornfields in the autumn, can ever become the gaudy flower of the florist? Even so indeed is it; the

savage woad-stained Britons, were not more different from the well-dressed ladies of the present day, than is the Heartsease from its wild state, since it has attracted the notice of the gardener. Those children of the wild Pansy, which you see in the borders of the flower-garden, have intermarried with strangers from other climates, and especially with one from the Altaic mountains (Viola altaica), where the race is finer and more vigorous than beneath our northern sky.

Before I close this letter let me survey the ground we have passed over. Eight distinct Natural Orders have been examined, all of which are so very easily known from each other, that it is almost superfluous to repeat their characters; yet as there is no more certain method of fixing these matters in the memory than by recapitulation from time to time, I must not only do so, but beg of you to endeavour to get the distinctive characters clearly understood and remembered by our little students.

Let me now vary the mode of distinguishing them, and put their characters before you in a new form.

Of the eight orders, three have an inferior ovary, and five have a superior ovary; we will take this very conspicuous character, as a preliminary mode of distinction; for thus we shall simplify the other differences. Then, of the three which have the inferior ovary, the Evening Primrose tribe has its parts of fructification in fours, the Umbelliferous tribe bears flowers in umbels, and the Myrtle tribe has a great many stamens and aromatic dotted leaves. On the

other hand, those with superior ovaries may be first separated into such as have a great many stamens, and such as have only a small and certain number. Of the former you have the Crowfoot and the Poppy tribe, the first of which has several distinct carpels, and the last all the carpels grown together into a hollow case; of the latter the Geranium tribe has the carpels separating from a long hard beak-like centre, the Cruciferous tribe has six stamens of which four are longer than the others, the Violet tribe has anthers with a membranous crest, and a fruit splitting into three valves, to the middle of which the seeds are fastened. This will be still clearer to you if put into the shape of a table.

- Ovary inferior
  - Parts in fours—*Evening Primroses.*
  - Parts not in fours
    - Flowers in umbels—*Umbelliferous Plants.*
    - Flowers not in umbels—*Myrtles.*
- Ovary superior
  - a great many stamens
    - carpels separate—*Crowfoots.*
    - carpels joined into a hollow case } *Poppies.*
  - few stamens
    - carpels separating from a long beak } *Geraniums.*
    - carpels not separating from a long beak
      - Five Stamens—*Violets.*
      - Six stamens, two of which are short } *Cruciferous Plants.*

This table is of no other use than to shew you how to analyse the characters of the subjects you examine; it does not give you, as you must remark, a correct

notion of the *essential* characters of any of the tribes, but it states clearly how they *differ* from each other. They differ from each other in many other respects, but it was not necessary to express any thing further in order to enable you to know them from each other.

EXPLANATION OF PLATE IV.

I. THE CRUCIFEROUS TRIBE.—A sprig of *Shepherd's Purse.*—1. A flower with all its parts in their natural position.—2. The same flower without the calyx and corolla ; it shews the two side stamens, which are the shortest.—3. An ovary cut across, exposing the partition, the two cavities and the young seeds, or ovules.—4. An ovule apart, with the end by which it hangs from the side of the partition. 5. The stigma, with the style and a portion of the shoulders of the ovary.—6. A ripe silicle ; *a a* the valves ; *b* the point of the partition.—7. The partition, from which the valves have been removed, shewing the numerous seeds which hang to it.—8. The partition seen in front, with the marks of the places to which the seeds were attached.—9. A ripe seed, covered with fine hairs.—10. The same cut through perpendicularly, shewing how the embryo is doubled up within it.—11. The same seed, cut through horizontally ; *a* the radicle ; *b* the two cotyledons.—12. An embryo pulled out of the seed-coat and straightened.

II. THE VIOLET TRIBE.—A. A piece of *Heartsease* ; *a* blade of the leaf ; *b b* stipules.—1. A view of the stamens and pistil in their natural position, after the petals and sepals are pulled off.—2. One of the horned stamens seen in face ; and, 3. the same seen from behind ; in both *a* represents the membrane, which is characteristic of the natural order.—4. A regular anther, seen in face.—5. A pistil.—6. The ovary cut through to exhibit the three elevated lines on which the seeds are placed.—7. A front view of the hole that leads to the stigma.—8. The head of the stigma split open, with a view of the stigmatic interior.—9. A ripe fruit split into its three valves.—10. A seed.—11. The same cut perpendicularly to shew the embryo lying in the midst of albumen.

The Passion-flower Tribe.

V. 1.

Passion-flower.

The Tutsan Tribe.

V. 2.

Tall Tutsan.

LETTER V.

THE PASSION-FLOWER TRIBE—AFFINITY—THE GOURD TRIBE—THE TUTSAN TRIBE.

(Plate V.)

When the Spaniards discovered America they found among other curious things, a flower, which they thought was an allegorical representation of the crucifixion and sufferings of our Saviour. In its anthers they saw his five wounds, in the three styles the nails by which he was fixed to the cross, and in a column which rises from the bottom of the flower the pillar to which he was bound; a number of little fleshy threads which spread from its cup, they compared to the crown of thorns. There are cuts, says Sir James Smith, to be found in some old books, apparently drawn from description, like the hog in armour upon our signs to represent the rhinoceros, in which the flower is made up of the very things themselves (*Rees's Cyclopædia*).

Such travellers' stories as this, would now find few persons credulous enough to believe them; the tale is, however, not wholly fabulous. Like many others of the same sort it is composed of truth mingled either with falsehood or excessive exaggeration. There is such a flower, and a highly curious one it is; and so

far from rare, that you are probably already well acquainted with it, for it is now frequently to be seen trained even to cottage walls.

You are surprised at this, and I dare say wonder what this strange flower can be that you have so often seen without discovering in it any of the marvels of the good Spaniards. They called it, in allusion to its mystical attributes, *Flos Passionis*, a Latin name signifying—Passion-flower, which the moderns have retained.

Many species with this remarkable character are known in gardens; they are all Passion-flowers, and are the representatives of the *Passion-flower tribe*. In other countries, other singular plants are also found, not exactly Passion-flowers, but belonging to the same tribe; as you are never likely to meet with them, I need not trouble you about the manner in which they are distinguished. We will satisfy ourselves with a botanical view of that to which so strange a story is attached.

The Passion-flower is a twining plant which helps itself to rise upon others by tendrils like those of the Pea, with which it often scrambles to the tops of high trees, or, if it misses its hold in the ascent, or is by any accident separated from the prop it has selected, hangs down among the branches in elegant festoons. Its leaves are veined in the netted manner; and are often divided into deep lobes, but not always; their stalks bear here and there upon their upper edge little hard dark-green shining warts, called *glands*; and they have a pair of stipules at their base.

The stems when cut through, shew the Exogenous structure; a circumstance you would have known by aid of the leaves alone, if you had not had the stem to cut.

The flowers have on the outside three large bracts (Plate V. 1. *fig.* 1. *a.*), which together form an involucre. Next these is a calyx, composed of five sepals (*fig.* 1. *b.*) which are generally green on the outside, and differently coloured in the inside; sometimes blue, sometimes purple, now and then yellow or some other colour. Let me particularly call your attention to this, which is a proof that the calyx, in other plants as well as in the Fuchsia, is occasionally coloured like petals. When you are more of a Botanist you will find that this fact is connected with a curious tale of *vegetable transformations*, which I may some day relate to you. At the base the sepals are joined together in a shallow cup, from which the petals and other parts arise.

The petals (*fig.* 1. *c.*) are always of the same colour as the inside of the sepals; but are nearly alike on both sides, are narrower, and are without a singular little horn, which projects from the back of the sepals, just as other horns spring from the corslet of certain beetles.

Next the petals come—the stamens, you will say:—not at all. Next the petals come several rings of beautiful fleshy threads, which spread from the cup like rays, and are splendidly mottled with azure and crimson and white. If there be one part of a plant more beautiful than all others, it is this

ray (or crown of thorns, as the Spaniards called it) in the Passion-flower; the crimson blotches upon it really do look like stains of blood. It diminishes gradually in size towards the inside of the flower, till at last it loses itself in some little rings, one of which often surrounds the base of the column we have still to examine in the centre (*fig. 2. a.*). Botanists themselves are hardly agreed upon the real nature of these singular rays; while some think them imperfect petals, others think them imperfect stamens: a question of very little moment, and which you are, as yet, unprepared to discuss; they are, probably, parts in a state of change from one to the other.

In the very centre of the flower, from the bottom of the cup, rises a column (*fig. 2.*), at the top of which are five stamens, each with a narrow two-lobed anther, swinging from the point of a flat filament; you will wonder to see that these anthers instead of turning their faces to the stigmas, like most other anthers, are so contrived as to turn their backs upon them; so that when they burst the pollen cannot fall upon the stigmas. This, however incomprehensible an arrangement it may appear to us, is by no means an event of unfrequent occurrence, as you will hereafter discover; nobody has yet found out the cause of it. What now is the column from which the stamens seem to rise? The base of the filament, you say. To a certain extent, you are right. The outside of the column, which is speckled like the filaments, is constructed, as you imagine; but if you cut it you will

find it is only a hollow sheath surrounding a solid slender cylinder, from the top of which grows the ovary. It is an unusual thing to find ovaries that have a stalk in the inside of the flower: but such a structure is not found in the Passion-flower alone.

The ovary is an egg-shaped part, which, when you cut it, is seen to consist of a single cavity, from three elevated lines in which spring the ovules, just as in the Violet. It is surmounted by three styles, which are thicker at top than at bottom, and terminated by thick swoln stigmas. This peculiar form, no doubt, suggested the idea of their representing the three nails of the cross.

Thus you see, when this flower is stripped of all that is fabulous, there is still enough left in it to excite our admiration.

The fruit is, in all cases, a fleshy egg-shaped body, containing a number of pulpy seeds; but it varies exceedingly in size and colour in different species. In the common blue Passion-flower, it is about as big as a hen's egg, and orange-yellow; in others, it is smaller, and quite round (*fig.* 3.); in others, it is as large as a child's head. Fruit of the latter size are sometimes cultivated for the sake of the sub-acid pulp they contain, and are called *Granadillas;* they are more esteemed in tropical countries, where the eatable fruits are generally bad, than in England, where we have so many really delicious fruits of our own.

If you were to look at the seed, you would say it was merely covered by pulp; there is, how-

ever, something even here, beyond what you at first perceive. Were you to watch the ovule in its progress to become a seed, you would remark a fleshy sort of jacket, gradually rising from the bottom of the ovule, overspreading its surface day after day, till it had completely enclosed it: and then, on a sudden, becoming soft and pulpy. Such a part as this we Botanists call the ARILLUS; a part you have often seen in another plant without knowing what it was. The spice called *Mace* overspreads the Nutmeg, as its jacket does the seed of the Passion-flower, and is the arillus of that aromatic production.

The seed may be easily deprived of the pulpy arillus, which will strip back (*fig.* 6.); and then you will discover that the seed itself is a blackish body, with a brittle sculptured shell (*fig.* 8.). I shall not trouble you about the contents of the seed, further than to say, that they are sweet like a nut, and as good to eat.

The only plant belonging to the Passion-flower tribe, which you will find in the gardens, besides Passion-flower herself, is a genus named *Tacsonia* (see *Botanical Register*, tab. 1536.), which is also found in South America, and is so like a Passion-flower, that you will hardly distinguish it, except by the very long tube of its flower. Its rays are short, so that it has, in some respects, less beauty; but the richness of its colours, and the large size of all its parts, amply compensate for this defect.

But, although there is no other genus of the same tribe within your reach, there are several belonging to

another tribe with which your children must be familiar, without calling science to their aid. They certainly have practical Botany enough to know a Melon, and a Cucumber; and, probably, also a Gourd, a Vegetable Marrow, and a Spirting Cucumber. Those things form part of a small natural order called after one of them, the *Gourd Tribe*, which is in near *affinity*, as we say, with the Passion-flowers. Now, this word affinity is one of the great practical difficulties in the way of the student of the Natural System of Botany. Not that it need be made so; for I have no doubt I could have taken you to the end of our intended journey, without saying a word to you about the matter. But to understand it is essential to those who would form a higher notion of Botany than what can be gathered from the mere power of distinguishing one thing from another; and if it could be comprehended, would form a great aid to you in your future progress. I shall, therefore, take the present opportunity of saying something about the way in which the word is applied, in the hope that I may make it clearer to you than it seems to be to many. Nevertheless, if you do not understand me, you may skip all that follows upon the subject.

AFFINITY signifies resemblance in *most* characters of importance. It differs in degree just as resemblances between animals, which you can see and understand more readily than those between plants. Thus a monkey or baboon are very nearly related to man, although totally distinct; that is, they resemble man in *most* characters of importance; and are therefore in affinity with him. Again, a cat and

a lion agree in a very great number of their principal points of organization; and are therefore in affinity also. But a cat and a bird, although both of the animal kingdom, disagree in the greater part of their structure; they therefore are not in affinity with each other.

To take an illustration from plants you are now familiar with, compare the Crowfoots with the Myrtles; they both bear flowers composed of calyx, corolla, numerous stamens and pistils, and they both have leaves with netted veins and consequently an exogenous structure; but here their resemblance ceases.—Compared as to other circumstances they are extremely different: as you will see by studying the two following columns:—

Crowfoots have	Myrtles have
Lobed *leaves*, with an acrid watery juice, and usually with an alternate insertion on the stem.	*Leaves* not at all lobed, usually with an opposite insertion on the stem, and with a volatile oily juice, which is lodged in little transparent spots.
Numerous *stamens*, arising from below the carpels.	Numerous *stamens* arising from the sides of the calyx.
A superior *pistil*, consisting of several carpels, either not at all or but slightly adhering to each other.	An inferior *pistil*, consisting of several carpels, which are all grown into one solid body at the top of the fruit-stalk.
As many *styles* as carpels.	Only one *style*, whatever the number of carpels.
A very little *embryo*, which is furnished with a great quantity of albumen for its nourishment when young.	An *embryo*, which is supplied with no albumen for its nourishment when young.
They are chiefly *herbs*.	They are all *trees* or *shrubs*.

Thus in all these six important circumstances the Crowfoots and Myrtles are extremely dissimilar; therefore they are *not* in affinity with each other.

Next let us compare Evening Primroses and Myrtles, which we have seen disagree in the former having the parts of the flower always divided by four, no oil spots in their leaves, and but a small number of stamens. Compared as to other circumstances they are extremely similar, as the following columns will shew:—

Evening Primroses have	Myrtles have
Leaves sometimes opposite.	*Leaves* usually opposite.
Stamens arising from the sides of the calyx.	*Stamens* arising from the sides of the calyx.
An inferior *pistil* with many seeds.	An inferior *pistil* with many seeds.
Only one *style*.	Only one *style*.
A *fruit* which is sometimes pulpy.	A *fruit* which is usually pulpy.
An *embryo* with no albuminous provision for its infancy.	An *embryo* with no albuminous provision for its infancy.

Thus in these important circumstances the Evening Primroses and Myrtles essentially agree; therefore they *are* in affinity with each other. You will further remark, that the points of difference between them in structure are no greater than what I just now mentioned; so that the points of resemblance *are much more numerous than the points of difference.*

Having thus given you an idea of the meaning of the word affinity as used in Botany, let me resume my account of the Gourds, which are in near affinity with the Passion-flowers.

A Cucumber, which is one of the Gourd tribe, has a twining, scrambling stem, and raises itself by ten-

drils; its leaves have a netted arrangement of the veins; its flowers have a calyx which is like petals in colour; its stamens grow into a central column; its ovary has only one cavity, with the seeds attached to three lines which pass up its sides; its ripe fruit is succulent in the inside; and its seeds have a sweet nutty taste. All this reads as if I were really talking of a Passion-flower; it is these numerous points of resemblance, in important points of structure, which constitute the affinity between the tribes of the Passion-flower and Gourd. In other respects they are materially different.

The Cucumber has very rough leaves; it has no petals; its stamens grow in one flower, and its pistil in another; the ovary is inferior; and there is no trace of the beautiful rays of the Passion-flower. All the Gourd tribe participates in these differences, which thus become the essential characters of that natural order.

The Passion-flowers are all harmless, and the fruit of many of them is eaten. Here we have another similarity, you will exclaim. Not quite so fast, if you please; I would not advise you to adopt that idea practically, for if you do you may share the fate of the poor sailor, who lately perished, as the newspapers tell us, from drinking out of a gourd-shell. In some countries there are Gourds with a very singular figure; they resemble a Florence flask, such as oil comes home in, and have a hard rind filled with soft pulp. Very useful bottles are prepared from such fruit, by cutting off the end of the

narrow part which represents the neck of the bottle, and then scooping out all the inside; but it is necessary before using them that all the pulp should be removed, and that water should be allowed to stand in them, and be changed several times, till all the bitterness in which the rind abounds be removed; owing to the purpose to which the fruit is then applied the plant itself is called the Bottle-Gourd.

The bitter matter which is thus removed by washing, is not only unpleasant, but actually poisonous, as the unfortunate accident I have alluded to sufficiently proved. You will be surprised to hear that it exists universally in the whole of the Gourd tribe, even in the Cucumbers and Melons which you have so often eaten without being poisoned; the truth is, that in these fruits the bitterness is dispersed through so large a quantity of pulp, and there is so little of it, that we are not sensible of its presence; while in the Bottle-Gourd and others, it is so highly concentrated as to become dangerous. That it is found even in the Cucumber you may easily believe, if you call to mind how often that fruit is bitter even when upon the dinner table.

You will therefore recollect that the Passion-flower tribe is universally harmless; but that the Gourd tribe is so often unwholesome, that the two or three instances you know of its fruit being eatable are to be considered exceptions to the rule.

The length of this letter has already so much exceeded my intention, that I must bring it to a close

with a brief account of a little natural order of wild flowers, which we may dismiss without giving you much more to learn.

The old herbalists had a plant which they called *Tutsan* (Hypericum); a corruption of the French Toute-sain, which we might translate "Allheal"; they also named it Androsæmum, which being translated signifies "Mans-blood," an odd name, which originated in the soft fruit staining the fingers red when bruised, and in a deep red colour being communicated by the leaves to oily or spirituous medicines in which the plant was often employed. This and others of a similar kind are common in meadows, and bogs, on heaths, in groves and thickets, and by way-sides, which they adorn with their bright yellow flowers. The species which I have selected for examination is a frequent inhabitant of shrubberies, but not a wild plant; it is called "the tall" (H. elatum); if you have it not at hand any other will do as well.

Its leaves have netted veins, are of an oval figure, are placed in opposite pairs round the stem, upon which they are seated without any stalks. If you rub them they emit a strong penetrating disagreeable odour; the cause of which you may discover by holding them against the light. They will be seen to be filled with transparent dots, crowded together and so minute that you perhaps may require a magnifying glass to discover them. It does not always happen that these dots are very small; on the contrary in one of our wild species they are so large that the leaves look as if bored full of holes, on which ac-

count the species has acquired the name of "the perforated."

The flowers grow in loose clusters at the tops of the shoots; their calyx consists of five sepals which are unequal in size, and which overlap each other curiously at the edges when the flowers are very young. To see this arrangement, cut a young flower-bud across, and you will find that the two largest sepals are on the outside of all (Plate V. 2. *fig.* 1**); next one of these is a smaller, of which one edge is covered by one of the large sepals, and the other lies upon the edge of a still smaller one within it; the last is matched by a fifth of the same size as itself, standing on the opposite side of the flower.

The petals are five, of a bright yellow, and very large for the size of the flower. At the base of the petals, and from below the pistil, arises a great number of stamens of unequal lengths, with very fine yellow filaments, and small roundish anthers; if you take hold of a few of these stamens with your fingers and pull them, a cluster will separate from the rest (*fig.* 3.); and if you will pull the remainder they also will come away in four other parcels; so that the stamens are really united into five different parcels, although till you began to separate them you did not discover it to be the fact. This is a curious circumstance to which you will find few parallels in other plants.

The pistil is an oblong body (*fig.* 4.) terminated by three styles, each of which is tipped with a little stigma. The inside of the ovary contains three cells, in each of which is a multitude of ovules; to speak

very correctly this pistil is composed of three carpels adhering to each other.

The ripe fruit is just like the pistil, except that it is darker-coloured, larger, and destitute of styles, which drop off shortly after the ovules are fertilized; it finally (*fig.* 7.) divides into three pieces or valves, each of which is one carpel; so that the adhesion between the carpels which took place when the flower was exceedingly young, does not cease till the fruit arrives at a state of dissolution. The seeds are very minute, but worth examining for their exceeding beauty. They are of an oval form, and up one side runs a curious crest (*fig.* 8.) which gives the seed something the appearance of an ancient helmet.

This plant represents the characters of an order called the *Tutsan tribe* (Hypericaceæ), into which enter few other genera besides that which comprehends our wild flowers. Among them, however, are some, found in the tropical parts of America, called Vismias, which yield a resinous substance resembling gamboge. In fact, something of the same kind may be traced in many of the Tutsans themselves. True, gamboge is itself the produce of a tree of the natural order Guttiferæ, to which belongs, among others, the Mangosteen tree, which bears the most delicious fruit in the world; that natural order has an exceedingly strong affinity with the Tutsan tribe.

I need not recapitulate the characters of the orders explained in this letter, as they are so very distinct that you may safely be left on this occasion to your own ingenuity. In my next letter I shall present you with some very interesting subjects.

EXPLANATION OF PLATE V.

I. The Passion-Flower Tribe.—1. A full-blown flower of the *Laurel-leaved Passion-flower*; *a* the involucre, *b* the sepals, *c* the petals.—2. A column of stamens; *a* the last ring of the rays.—3. A ripe fruit of the *Red-stemmed Passion-flower*.—4. The same cut through, to shew the manner in which the seeds are attached.—5. A seed, natural size, with its arillus on.—6. The same, with the arillus stripped back.—7. A seed magnified, with the arillus on.—8. The same with the arillus off; shewing the sculptured seed-coat.—9. A seed cut through; the embryo is seen lying in the midst of albumen in small quantity.—10. An embryo extracted from the seed, with its broad leaf-like cotyledons, and small tapering radicle. (N. B. These are copied from drawings by Mr. Ferdinand Bauer.)

II. The Tutsan Tribe.—1*. A flower-bud of *Tall Tutsan*, shewing the calyx.—1**. A view of the manner in which the sepals are respectively arranged when the bud is young.—2. A full-blown flower.—3. One of the five parcels of stamens.—4. A pistil.—5. A fruit three-quarters ripe.—6. The same cut through, to shew how the inside is arranged.—7. The ripe fruit separating into its constituent carpels; which leave behind three pieces of their edge, in the shape of three narrow plates, to which the seeds once grew.—8. A seed very highly magnified.—9. A section of the same, shewing the two cotyledons, and *a*, the thickness of the crest.

LETTER VI.

THE MALLOW TRIBE—THE ORANGE TRIBE.

(Plate VI.)

Well do I remember the pleasure I used to have, when a little fellow just sent to school, in gathering cheeses out of the hedges: it was my first step in Botany; and it was not without pride that I found myself able to shew my less learned companions how to distinguish the plants that bore those delicacies. Many years after, when the cares and pleasures of life had blotted out all remembrance of the joys of childhood, I was passing a few days in Normandy, with my friend M. de P., when, one day, his little girls came running to me with their hands filled with fine plump *fromageons;* I know not whether it was the association of ideas that the well-remembered word conjured up, or the sweet countenances of those dear children, joy painted in their black and sparkling eyes, and health in their rosy cheeks—but I ate their fromageons with as much delight as ever, and fancied them as superior to all the fruits of the garden in flavour, as they are in perfect symmetry of form. Only compare a vegetable cheese, with all that is exquisite in marking, or beautiful in arrangement in the works of man, and how poor

The Mallow Tribe. VI. 1.

Larger Mallow.

The Orange Tribe. VI. 2.

Sweet Orange.

and contemptible do the latter appear! Not only, when seeing it with the naked eye, are we struck with admiration at the wondrous perfection and skill with which so obscure a point in the creation is constructed; but, using our micrcoscope, surprise is converted into amazement, when we behold fresh beauties constantly revealed, as the magnifying power is increased, till at last, when the latter reaches its limit, we find ourselves still regarding a lovely prospect, the horizon of which recedes as we advance. Nor is it alone externally that this inimitable beauty is to be discovered; cut the cheese across, and every slice brings to view cells and partitions, and seeds, and embryos, arranged with an unvarying regularity, which would be past belief if we did not know, from experience, how far beyond all that the mind can conceive, is the symmetry with which the works of nature are constructed.

> Look, then, who list your gazeful eyes to feede
> With sighte of that is faire, look on the frame
> Of this wide universe, and therein reade
> The endless formes of creatures, which by name
> Thou canst not count; much less their natures aime;
> All which are made with wondrous wise intent,
> And all with admirable beauty blent.

I perceive, I have been talking of these curious productions, as if you were already acquainted with them; while it is quite possible that you are not. In that case, step to the road-side, or to the first patch of weeds you can meet with, and there you will be sure

to find what is called a Mallow; we have two very common sorts; one of which has small pink flowers; the other, large striped purple ones; the latter is one of our handsomest wild flowers, and is called "the common," or, *the larger Mallow* (Malva sylvestris); it is that you are to take as the subject of your study.

This plant (Plate VI. 1.) grows two or even three feet high, in places where it is not cropped by cattle. It has an erect branching stem, of a very pale green, covered all over with longish hairs, which frequently spring from the surface of the stem in starry (or, as we pedantically say, *stellate*) clusters. The leaves are roundish, and divided into about five shallow lobes, the border of which is notched; their veins are netted. At the base of the leaf-stalk grows a pair of small stipules, resembling scales.

From the bosom of the leaves spring the flowers singly. Below the calyx are placed three small bracts, forming an involucre (*fig.* 3. *a.*). The calyx is composed of five sepals, joined together about half-way; it is quite soft, with long delicate hairs. Five large rosy-purple striped petals, each of which has almost the figure of a wedge, and is notched at the end, constitute the corolla, which spreads wide open, when its proper time for unfolding arrives; before that time, its petals were curiously twisted together.

The stamens are very different from any we have yet examined; they consist of a hollow column, bearing, at its upper end, a great number of anthers,

each of which has a short filament (*fig.* 1.), and is of a kidney shape, containing only one cell instead of two, as is usual. Formerly Botanists were contented to call this column, a column, and to inquire no further; as if they thought it was some new and special organ found only in such plants as the Mallow. At the present day we are too curious to be thus easily contented, and we must have the exact nature of every part explained. This column, then, is caused by the filaments growing fast together, when they are very young, without being able to separate afterwards, except just at the top, where they look like filaments. Suppose the stamens of the Tutsan were joined together in this way, when young, you would have exactly such a column as is constantly produced in the Mallow.

The next object of examination is the pistil (*fig.* 2.); it is formed of several carpels, which grow together in a circle round a common centre, and so form a sort of flat plate, from the middle of which the styles arise. Like the filaments, the styles also grow together at the bottom into a column, but they soon separate again, and then you may tell, by counting them, that each carpel has its own style, for there is exactly as many styles as carpels.

Last comes our acquaintance the cheese, in the shape of the nearly ripe fruit; we will suppose it to be quite ripe (*fig.* 4.), for the sake of avoiding repetition. It consists of a number of dry carpels which will separate readily from each other and from the central body to which they were originally joined.

Each carpel (*fig.* 5.) contains one seed, with an embryo curiously doubled up and filling the whole of the cavity; hence as the carpels are all of the same size, and arranged with the most exact regularity on the same level, if a fruit is cut through it will present a singularly beautiful arrangement of the parts, which look like a vegetable star. In the centre, if the fruit is not ripe, is a solid circle from which eleven rays branch off at regular distances, each being sub-divided into two. Between the rays lie eleven embryos, the various convolutions of which, as cut through by the knife, exhibit eleven areas of strange patterns. The kaleidoscope itself can produce nothing prettier than this, except in colour.

This account is that of all the Mallow tribe in most respects; and is quite sufficient to enable you to identify it: a power that it is useful to possess because the species are all perfectly innocent. The columnar stamens themselves suffice in a majority of cases.

The species yield a large quantity of a ropy transparent almost tasteless fluid, in all the green parts; and it is for this that the cheeses are sought with so much avidity. In India a daily use is made of the cheeses of a Malvaceous plant called *Ochro*, or in some places *Gobbo* (Hibiscus esculentus), the mucilage of which is in great request for thickening soups: it is even imported in a dry state into England. Marsh Mallow, which possesses this mucilaginous quality in a high degree, in all its parts, is a favourite material with many physicians, especially the French, for poultices.

We are, however, far from exhausting the properties

of the Mallow tribe in talking of its mucilage. It has many other and far more important good qualities. In beauty it yields to no part of the vegetable world; many of the plants called Hibiscus, are trees or shrubs or herbs bearing flowers of the largest size, the most exquisite proportions and the most striking colours; the common *Bladder ketmia* for example. One of them, conspicuous for the brilliant crimson of its flowers (Hibiscus Rosa Sinensis), is a vegetable shoe-black; the petals communicate a black stain to any thing they touch, and the Chinese actually black their shoes with them. Many varieties of it are common in our hot-houses, so that you may try the experiment on your own shoes if you like.

Cordage is also produced by several species, from the tough vegetable fibres of their stem. But it is the hairy clothing of the seeds of different plants belonging to a genus that Botanists call Gossypium, which is of such pre-eminent importance as to claim for the Mallow tribe a rank in the vegetable kingdom second only to Corn. That hairy substance is Cotton, which for no conceivable purpose except to yield man the means of clothing himself, is formed in prodigious abundance upon the back of the seeds of the Cotton plants, whence it is torn by machinery and afterwards cleaned and spun into thread. Faithless travellers and credulous readers for a long time caused the existence of the Barometz, or Scythian Lamb, to be believed in, a creature said to be half animal half plant; the Cotton plant has far stronger claims to the name of a vegetable sheep.

The simplicity of its characters and the remarkable arrangement of its stamens, render it unnecessary for me to dwell longer upon this natural order.

The next to which I shall direct your attention, is that of the Orange, in which I hope to make your little pupils take as much interest botanically, as they already do in a more practical way.

Oranges, Shaddocks, Limes, Lemons, Forbidden Fruit, and the like, are all produced by plants which represent a tribe perfectly distinct from the rest of the vegetable kingdom, and which we call the *Orange tribe.* The are all natives of countries warmer than this, and principally of the temperate parts of India; their fruit is in all cases eatable, although not always worth eating; their leaves and flowers all fragrant, and they are universally evergreens of beautiful appearance. The cells filled with oil, which you find in cutting the rind of an orange, are met with in both leaves and flowers, to which they often give the appearance of being covered with little blisters; and, as usual, it is in them that the sweet odours are stored up.

To understand the structure of this interesting tribe, let us take the common sweet Orange, a plant or two of which is kept in every green-house, for the sake of the delicious fragrance of the flowers. It has leaves with netted veins, and filled with transparent spots (*fig.* 6.); they are always jointed just above the footstalk, so that each leaf will readily snap asunder in two pieces. The calyx is a little cup with five shallow teeth: so complete is the combina-

tion between the sepals of which it is composed. Five white fleshy green-dotted petals are placed within the calyx, and within them are ten or twelve stamens that arise from under the pistil; these grow together, in a way that explains well enough the real nature of the column of the Mallow tribe, but that is not characteristic of the Orange tribe itself.

The pistil (*fig.* 4.) is a round dark-green part, terminated by a thick style and stigma: around its base is stretched (*fig.* 6. *a.*) a ring, out of the outside of which the stamens originate. If you cut into the ovary, you will find it contains several cells, in each of which is a double row of ovules (*figs.* 5 and 6.).

Thus far there is nothing but a peculiar combination of parts, with all which you are already quite familiar. But as soon as the ovary begins to grow into a fruit, a great change comes over it: numbers of the ovules perish; the thickest part of the rind begins to separate from the lining, and finally becomes so loose that, as you know, it is easily peeled off; and at the same time a great quantity of little pulpy bags jut forwards into the cavity of each cell, becoming more and more watery, more and more acid, and then more and more sweet, till at last the whole substance of the fruit is a mass of sweet and delicious pulp. The nature of these bags cannot be readily seen in the Oranges of the shops, but if you examine a bad Orange, such as is usually produced in a greenhouse, the structure becomes most obvious.

Do not, however, suppose that the presence of pulpy bags in the midst of the cells of the fruit is an

essential character of the Orange *tribe;* on the contrary, it is peculiar to the Orange *genus* (Citrus) only. In all the other genera the fruit is fleshy and fragrant, but not pulpy in the inside.

So few plants related to the Orange are ever likely to be met with by you, that I should only fatigue you unprofitably in repeating their names. Let us conclude, then, for this time with the essential character of the Orange tribe, which, if reduced to its simplest form, may be expressed thus:—

Leaves, flowers, and fruit, filled with transparent receptacles of fragrant volatile oil. Leaves jointed, once at least, above the footstalk. Stamens few and hypogynous. Fruit fleshy.

To compensate for the length of some of my former letters this is unusually short; for which I suspect you will be inclined to thank rather than to blame me.

EXPLANATION OF PLATE VI.

I. The Mallow Tribe.—A sprig of *the larger Mallow* (Malva sylvestris).—1. An anther with the upper part of the filament.—2. A pistil, shewing the ovary, column-like base of the styles, and the styles themselves—3. A calyx closed over the growing fruit, with leaves of the involucre at *a*.—4. A ripe fruit ready to separate into distinct carpels.—5. One of the carpels separated from the rest, and seen from its side.—6. The same, split in halves, to shew the embryo; from the position in which the embryo lies, only one of the cotyledons can be seen at *a; b* is the radicle.

II. The Orange Tribe.—A twig of the common *sweet Orange*. —1. A flower shewing the calyx, the petals spotted with oil, and the

tips of the stamens.—2. A stamen, with the anther viewed in front. —3. The same from behind.—4. A pistil, with its disk at *a*; at the lower edge of the ring or disk are seen the scars caused by the separation of the stamens.—5. A cross section of the ovary, shewing the numerous cells and double lines of ovules.—6. A perpendicular section of the same; even at this young period you may see in the rind of the ovary the receptacles in which oil is beginning to secrete; *a* the disk.—7. A portion of a leaf magnified so as to shew the oil cells.

LETTER VII.

THE CHICKWEED TRIBE—METAMORPHOSES OF PLANTS —THE PURSLANE TRIBE—SUCCULENT PLANTS—BREATHING-PORES.

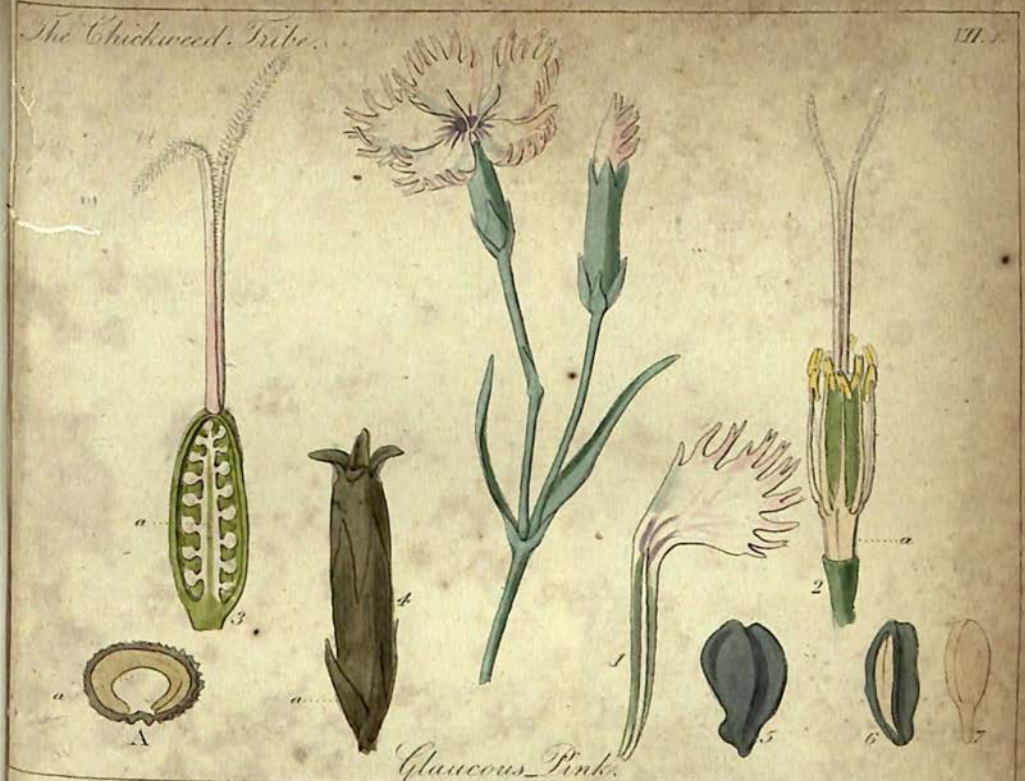
(Plate VII.)

From the earliest period of your familiarity with a garden, you must have been acquainted with those sweet aromatic flowers called *Pinks*, *Piccotees*, and *Carnations*, and you must have admired their beautiful stripes, and the symmetry with which their petals are arranged. It is also not improbable that you have some knowledge of a mean weed, called *Chickweed* (Stellaria media), which inhabits every neglected corner of your garden; *Corn Cockle* (Agrostemma Githago), *Bachelors Buttons* (Lychnis dioica), *Ragged Robin*, (Lychnis flos Cuculi), and many species of *Catchfly* (Silene) are also pretty flowers, that you will easily procure either by hunting for them in the fields, or by inquiry after them in gardens.

All these agree with each other in a number of characters which are so remarkable as to divide them from all other plants, and to cause them to be established as a distinct natural order called the *Chick-*

The Chickweed Tribe.

VII. 1.



Glaucous Pink.

The Purslane Tribe.

VII. 2.

Large flowered Calandrinia.

weed tribe; which is composed for the chief part of plants of little interest or beauty, among which there is not a single species with unwholesome properties. Uninteresting as many of them are, they are so common that every one who pretends to botanical knowledge must learn how to recognize them, even if it were not for the sake of the few kinds, which, like the Pink, are our familiar acquaintances.

To understand the structure of the Chickweed tribe, I shall not ask you to take the Chickweed itself, because it is a plant with very small flowers; let us rather seek some species in which all the parts can be easily seen; as a Pink for instance. Here is a pretty species, the *glaucous Pink* (Dianthus glaucus) of Scotland; if you have it not in your garden, any other will do as well, provided it is not double.

This little herb is called glaucous, from a Latin word signifying blueish-grey, because its leaves, like those of many other pinks, have such a colour in a remarkable degree. Its stems are very much swoln at the joints, where the leaves are set on. The leaves are exceedingly narrow, undivided, and rather rough at their edge; they have only one single vein which runs through them from one end to the other. How then are we to ascertain whether this plant is Exogenous or not? for there is nothing here to shew whether the veins have a netted structure; there is apparently only one vein to examine. I must confess this looks very like a difficulty; and I dare say you will now suppose that the time has come when you must have recourse to patience and a microscope,

to learn whether there are two cotyledons in the embryo or only one (see page 13); believe me, however, we have not yet arrived at so disheartening a point. There are in fact many ways of shewing you how to determine whether this is an Exogenous plant or not, without counting the seed-leaves. That which I select is one of the easiest to understand; but I must first mention a few matters that I have not hitherto touched upon.

You are no doubt acquainted with some of the idle tales that are told by the ancient poets, of people being changed into trees, or animals, or rocks; one young lady for example, not only cried her eyes out, but was altogether changed into a running stream, and another was transformed into a spider, because she dared to emulate the goddess of wisdom in tent-stitch; these occurrences they called Metamorphoses, a name which Botanists have borrowed for something of a similar nature which really does happen in plants. Hitherto I have always spoken of the different parts of the flower as so many totally distinct organs, and it is undoubtedly true that the petals, stamens, and pistil have very different offices to perform. But, at the same time, it seems equally certain that all those, and several other parts, are in a very great degree constructed like leaves; that at a very early period, when they were first formed, they were absolutely the same as leaves of the same age; that it is only after they have been growing for some time that they begin to assume the characters under which they finally appear; and that consequently they are

very often found resuming the appearance of common leaves if any thing occurs to interfere with their intended structure before it is entirely fixed. Thus we find leaves in the place of petals, or as they say petals metamorphosed into leaves, in some kinds of double Tulips; sepals and pistils often changed to leaves in double Roses; all the parts of the flower turned into leaves in other plants; and a multitude of similar cases with which the Botanist is acquainted. You will find all this so fully demonstrated in my Introduction to Botany, Book vi., or in other works of a like nature, that there is no doubt of the fact; and the doctrine is now the foundation of modern views of the real structure of flowers and fruit. It is not my plan to enter into such questions in these letters, but I could not avoid calling your attention to the circumstance.

Now mark the practical application of this knowledge. If the parts of the flower are only leaves in a particular state, any of those parts in which veins can be discovered will serve to shew the arrangement of the veins as well as the true leaves themselves. In the Pink the petals are fully expanded, and full of veins; they are therefore fitting objects to examine; and their structure will tell us whether the Pink is Exogenous or not. You will find them distinctly netted, and thus that question is set at rest.

This then, which is an Exogenous plant, has opposite undivided leaves seated on the swoln joints of the stem. The calyx consists of a tube composed of five

sepals joined together and separated only near the points. Five petals arise from within them, each of which has a stalk and a blade; the stalks, or claws as they are called (*ungues*), are very narrow, and stand side by side within the calyx; the blades are much expanded, and irregularly lacerated at the end.

Stamens there are ten, rising from beneath the ovary, out of a short stalk (Plate VII. 1. *fig. 2. a.*). The ovary is superior, and contains but one cell, in the centre of which is a slender receptacle (*fig. 3. a.*), covered with a great many ovules. The styles are two, each terminating insensibly in very narrow fringed stigmas.

The fruit becomes a dry case or capsule, opening at the point with four teeth or valves (*fig.* 4.). The structure of the seed is variable, and not important for our present purpose.

Such is the character of the Pink, and such to a great extent is that of the tribe it represents. It may be said to consist in these marks. *Stems swoln at the joints; leaves opposite and undivided; stamens few and hypogynous; ovary with many styles, one cell, and a central receptacle covered with ovules.* Nothing like this has been previously shewn to you. The genera are very uniform in their structure, and are distinguished by marks that every one may observe. Two divisions are formed, one of which has the sepals united into a tube, the other has them all distinct.

In the first division is found the *Pink*, which is

known by the bracts at the base of its calyx (*fig.* 4. *a.*); and some others, of which the following are the most remarkable; Silene or *Catchfly* which has three styles and a crest at the top of the stalk of each petal; it derives its English name from its often secreting a viscid matter in which flies are caught; the *Cockle* (Agrostemma) which has five styles and undivided petals; Lychnis, to which the *Ragged Robin* (L. flos Cuculi), and *Batchelors Buttons* (L. dioica) belong; to say nothing of the splendid *Chalcedonian Lychnis* of the gardens, which has five styles and divided petals.

To the second division we refer *Chickweed* (Stellaria), which has three styles and two-lobed petals, *Sandwort* (Arenaria), which has three styles and undivided petals, and *Mouse-ear Chickweed* (Cerastium), which has five styles and a curiously shaped taper seed-case with ten teeth.

So little interest attaches to these plants that I leave them here, and proceed to notice another order which resembles them in many respects; and which is upon the whole more beautiful.

Imagine you have a Chickweed with *two sepals and one style*, all the other points of structure in the flower remaining the same; and you will have an order that, while it seems to resemble the Chickweed tribe so much as to be almost identical with it, nevertheless differs in several important particulars in the manner of growth. Not only are the leaves alternate instead of opposite, and the stem destitute of swellings at the joints, but there is a constant disposition on the part of the stems and leaves to become

fleshy, or as it is usually called succulent. Plants thus constructed belong to the *Purslane tribe*, so called because the now-forgotten Purslane, which was once in much esteem as a salad, belong to it. They are often remarkably beautiful on account of their bright red or yellow flowers; are always harmless and wholesome in their properties; but are sometimes, when the petals are small, mean-looking herbs.

You cannot take a better specimen of the Purslane tribe than the *large-flowered Calandrinia* (Plate VII. 2.), a Chilian plant that is now a good deal cultivated. Its soft and succulent stems and leaves are exceedingly dissimilar to those parts in the Chickweed tribe. The calyx is formed of two leaves (*figs.* 1. and 4.); there are five petals which pay their homage to the sun by unfolding their crimson drapery beneath his earliest beams, and rolling up again as soon as the light of his countenance is withdrawn. A considerable number of stamens succeed the petals; and in the centre is an ovary with one cell and a central receptacle covered with ovules; it is surmounted with a style which ends in a broad hairy lobed stigma. The fruit when ripe splits into four valves (*fig.* 4.); which allow the escape of a number of black seeds (*figs.* 5. and 6.), altogether resembling in their internal structure the seeds of most of the Chickweed tribe.

The obscure little *Water Chickweed* (Montia fontana); a neat looking American genus of hardy plants called Claytonia; the *Purslanes* themselves (Portulaca), many of which are very handsome; and the Chilian

Calandrinia are the most common representatives of the order.

While the principal part of the plants belonging to the Chickweed tribe is found in meadows, or shady spots, or in situations and climates where they are abundantly supplied with moisture, the Purslane tribe, on the contrary, chiefly rejoices in hot dry exposed places, where they will flourish at a time when every thing else has fallen a victim to drought and heat. They owe this power to the peculiar nature of their stems and leaves; which, as I have already mentioned, are succulent. They require, in consequence, a peculiar mode of cultivation, which I will now explain to you.

When I gave you in my first letter a brief account of the minute and beautiful arrangements by which leaves are able to perform their vital actions, I omitted to say anything about their breathing-pores or STOMATA. The time has now come when I must tell you what they are.

All leaves are covered by an exceedingly thin and delicate skin, which you may often peel off. If you put a small piece of this in water, and look at it with a microscope against the light, you will remark a number of very small roundish or oval spaces, through the middle of which a line passes. And if you have patience enough to look at a great many of them, you will in time perceive some of them opening a sort of mouth at the place where the line is. These are what are called breathing-pores; they are organs by which the leaves inhale and exhale air, or vapour

suspended in air. In some leaves they are extremely large and numerous, and such leaves perspire through the breathing-pores in very great quantity, as the Vine; in others they are so small or so few, as to admit of scarcely any perspiration, as in the Purslane, and in succulent plants in general. It is thought, indeed, that the character of succulence is owing to leaves being unable to get rid of the water absorbed by the roots, and so becoming, as it were, dropsical.

Attention to this difference in the power of perspiring in different plants is one of the keys to a knowledge of the right method of cultivating them and it has been applied for years to succulent plants, by keeping them in what is called a dry stove; that is to say in a hot-house, the air of which is kept dry by refraining from watering the floors or earthen pots in winter. Succulent plants are, when in a state of rapid growth, so imperfectly supplied with the means of perspiring, that they require all the assistance which can be obtained from a dry atmosphere, to be able to part, by the leaves, with the water that is impelled into them through their roots; and consequently, if ever, in a rapidly growing state, they are kept in a damp atmosphere, they become dropsical and unhealthy, or soon decay. But in the winter, the little power of perspiration which they possessed in the full vigour of their summer growth is very much diminished, and is in fact reduced to almost nothing. Their roots will nevertheless go on absorbing moisture from the soil as long as the soil contains

any, and this, if the moisture is in much quantity, is certain to produce decay and death, because the excess of water, which cannot be afterwards parted with by the leaves, becomes putrid. Such being the case, it is found necessary to deprive succulent plants of all water at their roots in winter, and to leave them for support to the vapour which always will exist in the air at that season in a climate like that of England.

It is for these reasons that succulent plants succeed so much better than others in sitting-rooms. In such situations, plants are killed by want of light, and want of moisture in the air; for the air of all sitting-rooms is necessarily very dry. But succulent plants apparently require less light than most other plants, and are certainly benefited rather than injured by a dry atmosphere. I should therefore advise you, if you are anxious to have a garden in your sitting apartment, to fill it with succulent plants, to the exclusion of all others.

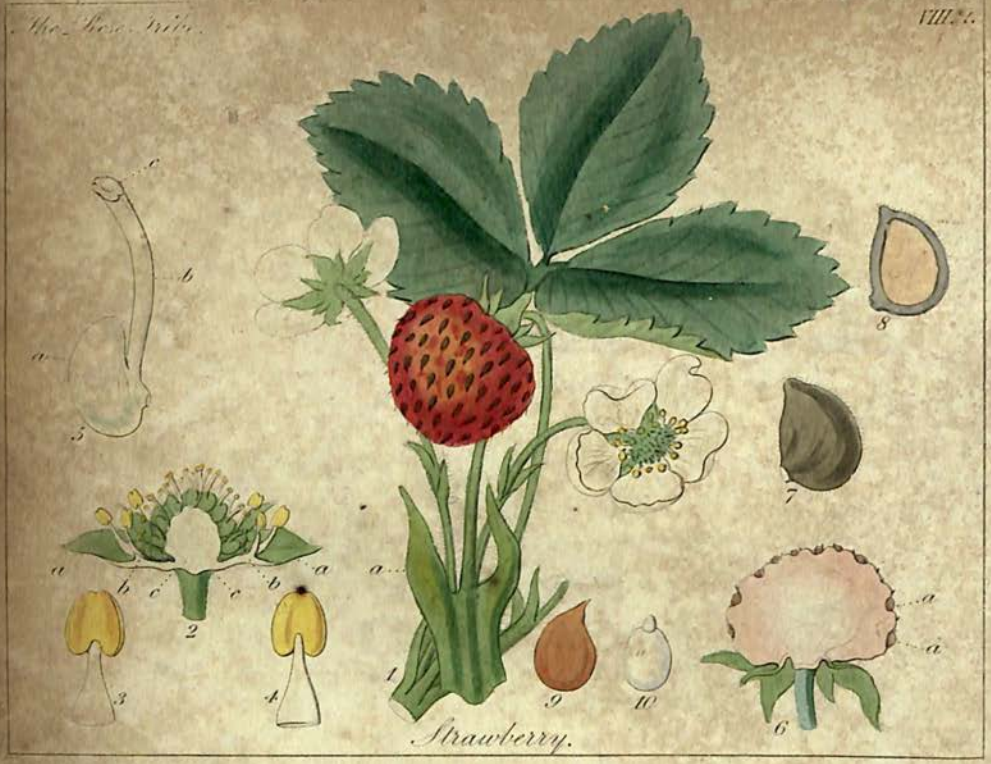
The Purslane tribe is far from being the only one in which succulent species are found; they might exist in any, and in fact do in a great many natural orders, the majority of whose species are not succulent; some orders, however, abound in them more than others, as for example, the *Houseleeks* (Crassulaceæ), the *Torch-thistles* (Cactaceæ), the *Asclepiadaceæ*, the *Euphorbias* (Euphorbiaceæ), and the *Asphodels* (Asphodeleæ).

But it is time that an end were put to this letter, especially as the next must, I fear, be a very long one.

EXPLANATION OF PLATE VII.

I. The Chickweed Tribe.—A piece of the *Glaucous Pink*.—1. A petal apart; on its stalk is a curious double raised plate.—2. The stamens and two stigmas, as seen when the calyx and corolla are cut off; *a* is the stalk of the ovary.—3. A perpendicular section of an ovary, shewing the central receptacle, *a*, on which the ovules grow. —4. The ripe fruit invested with its calyx, and having the bracts *a* at the base.—5. A seed.—6. The same divided perpendicularly, so as to shew the embryo.—7. An embryo taken out of the seed.—A. a seed of another plant, *Batchelors Buttons* (Lychnis dioica), cut through perpendicularly, and shewing the curved embryo; *a* albumen.

II. The Purslane Tribe.—A leaf and a portion of a flower-branch of *Large-flowered Calandrinia*.—1. A flower-bud, with the sepals, and the corolla peeping through it.—2. The stamens and pistil.—3. A perpendicular section of the ovary, shewing the central receptacle on which the ovules grow.—4. A fruit beginning to open, with the two sepals by which it is protected.—5. A seed, with a portion of its stalk.—6. The same cut through, to shew the embryo and the albumen, *a*.



Strawberry.

Narrow-leaved Vetchling.

LETTER VIII.

THE ROSE TRIBE—BUDDING AND GRAFTING—THE PEA TRIBE.

(Plate VIII.)

You, perhaps, remember, when you were beginning to study Botany, how you fell into the error of supposing that the Strawberry belongs to the Crowfoot tribe, and that I then explained to you the cause of your mistake. In this letter I propose to take the Strawberry, for the purpose of illustrating the natural order to which it belongs, which we call the *Rose tribe*, because the Rose is one of the genera comprehended in it. I am sure, that the mere mention of this favourite plant, will ensure your attention to the history of its relations.

The *Strawberry* (Fragaria) is a herb with three-parted leaves, and a pair of large membranous stipules at their base (Plate VIII. I. 1. *a*.). The veins of the leaves are netted. When the Strawberry plant is about to multiply itself, it puts forth naked shoots of two sorts: one of them is prostrate on the ground, and ends in a tuft of leaves, which root into the soil, thus forming a new plant; or, as it

is technically called, a *runner;* the other kind of shoot grows nearly erect, and bears, at its end, a tuft of flowers, which afterwards become fruit; or at least what is commonly called so.

The calyx of the Strawberry is a flat green hairy part, having ten divisions; it is, therefore, caused by the union of ten sepals, five of which are on the outside of the others, and smaller. As you become more and more acquainted with Botany, you will find that it is an extremely common thing for the parts of the flower to consist each of several rows. This is the first time I have mentioned it, and it is the first time it has occurred in the calyx; but you have already seen it in the rays of the Passion-flower, in both the stamens and carpels of Crowfoots, and in the stamens of many of the other orders we have passed by.

The corolla consists of five petals.

The stamens are very numerous, and are placed in a crowded ring round the pistil, as in the Crowfoot; but, you will observe, that they grow out of the side of the calyx (*fig.* 2.), and not from beneath the carpels.

The pistil of a Strawberry is very much like that of a Crowfoot: it consists of a number of carpels, arranged in many rows, and with great order, upon a central receptacle; each carpel has a style, which arises from below its point (*fig.* 5.), and terminates in a slightly-lobed stigma. In the inside of the ovary is one single ovule. With the flower, the resemblance between the Crowfoot and the Strawberry ceases.

You will almost wonder, now that you know how the young flower of a Strawberry is constructed, how so singular a fruit is to be formed out of such materials; especially if you should have chanced to meet with the ingenious explanation given of it by some Botanist, whose name I forget, that it is a *berry with its seeds on its outside.* Many and strange are often the changes that take place in the organization of a pistil in the course of its transformation into a fruit: and they are highly curious in this case. If you would really understand them, you should watch the Strawberry in the progress of its growth. You would then see that the first occurrence after the petals have fallen off, and the calyx closed on the tender fruit, consists in the receptacle of the carpels beginning to swell; and, shortly after, in the carpels themselves gaining a greater size and a more shining appearance; while, at the same time, their styles begin to shrivel up. At a more advanced stage, the carpels are found but little augmented in size, while the receptacle has increased so very much in dimensions, that the carpels are beginning to be separated by it, and the surface of the receptacle can be distinctly seen between them. A little older, and the carpels seem scattered, in an irregular manner, over the surface of the receptacle, which has become soft and juicy, while they have remained almost stationary in size. All along, the swelling receptacle has been pushing the calyx aside, as being no longer of use to it; and, at last, you scarcely remark the calyx, in consequence of the much greater size of the re-

ceptacle. This part finally gains a crimson colour, swells more and more rapidly, acquires sweetness and softness, and at last is the delicious fruit you are so well acquainted with:—in that, its final state, the carpels are scattered over its surface in the form of minute grains, looking like seeds, for which they are usually mistaken. You, however, know better than to fall into this common error; for you have seen, that, at first, they had each a style and stigma, which seeds never have; and you can now, by cutting them open (*fig.* 8.) detect the seed (*fig.* 9.) lying in the inside of the shell of the carpel. The Strawberry is, therefore, not exactly a fruit; but is merely a fleshy receptacle bearing fruit; the true fruit being the ripe carpels.

Cinquefoils (Potentilla), are little herbs, usually with pretty yellow flowers, found growing on banks and on commons, among the short grass; one of them is called *Silver-weed* (P. anscrina), on account of the white, and almost metallic, appearance of the underside of its leaves. They are so like the Strawberry in flower, that there is no Botanist who could tell you how to distinguish them in that state. But they do not bear Strawberries; that is to say, after their flower is withered, the receptacle does not become soft and pulpy; but it always remains hard and dry, and is completely hidden by the carpels. This plant, then, must be very nearly related to the Strawberry.

The *Raspberry* and *Bramble* (Rubus), also claim kindred with the Strawberry, because of their likeness to it. They are shrubby plants, having their

stems covered with hard hooked prickles; in this respect they differ from the Strawberry. Their leaves are divided, in various ways, according to their kinds, and have large stipules at the bottom of their stalks; here they agree with it. Their calyx has only five divisions instead of ten; which is a difference; but their petals are five; the stamens numerous, and arising out of the side of the calyx; and their pistil composed of a number of carpels arising out of a central receptacle; these, again, are resemblances with the Strawberry in important points. Let us examine the fruit. The Raspberry has a dry *core*, off which you may pull the little thimble-like fruit, and you will not find any of the dry grains which stick upon the outside of the Strawberry. But, look again; what are the little dry threads that you see rising from the centre of a multitude of little projections with which the whole surface of the Raspberry is covered? Surely they are styles; and, if so, the projections out of which they grow, must be carpels in a ripe state. This is really the case; the carpels of the Raspberry, instead of remaining dry as they become ripe, swell and acquire a soft pulpy coat, which, in time, becomes red: they are crowded so closely, that, by degrees, they press upon each other, and, at last, all grow together into the thimble-shaped part which you eat; in order to gain this succulent state, they are forced to rob the receptacle of all its juice, and, in the end, separate from it, so that when you gather the Raspberry, you throw away the receptacle under the name of core, never suspecting

that it is the very part you had just before been feasting upon in the Strawberry. In the one case, the receptacle robs the carpels of all their juice, in order to become gorged and bloated at their expense; in the other case, the carpels act in the same selfish manner upon the receptacle.

Another plant very like Cinquefoil is *Avens* (Geum), one species of which, called the *Herb Bennet* (G. urbanum), is common enough in hedge-rows. It grows a foot or two high, and has the leaves upon the stem in three lobes, while those at the bottom of it are in many divisions. The flower of this plant is so extremely like that of Cinquefoil, that you could not distinguish the two. But its fruit is a sort of bur, composed of innumerable stiff bristles, which all spring from one common centre, and are terminated by hooks at the point. The bristles are the styles which, like those of the Geranium, have grown stiff and long; and the hooks are the hardened points of them where they have curved back, and separated from an upper portion which drops off. The central part is a mass of carpels, the receptacle of which is hard and dry.

A beautiful mountain plant, frequently met with in the Alps of Europe, called *Mountain Avens* (Sieversia montana), and often seen in gardens, where it is cultivated for its large yellow flowers, and its diminutive stems covered with large deeply-lobed leaves, offers a further instance of the changes which the fruit of the Rose tribe undergoes between youth and old age. When the fruit of Mountain Avens is ripe,

it looks like a silken plume springing out of the cup of the calyx, and as it waves about in the wind one may almost fancy it a tuft of feathers accidentally fastened to the flower-stalk. A botanical examination dispels the illusion, and shews that the appearance is caused by the carpels having preserved their styles, which become very long and are covered all over with loose silky hair, which has grown since they were young. A similar phænomenon occurs in the *Virgin's bower* (Clematis), and in the *Pasque flower* (Anemone); but the most remarkable instance of the production of hairs so as to change the whole appearance of a part, is met with in the *Venetian Sumach* (Rhus Cotinus), which the French call *Arbre à perruque* or the Wig Tree. You have perhaps seen this plant, which is by no means uncommon in shrubberies, "shaking its hoary locks" at you as the breeze waved the branches, and set the wigs in motion, in the midst of a crowd of blood-stained leaves; if you have not, I would advise you to seek for it in the autumn, at which season only it wears its wig; in the spring and summer it does not want it and will not put it on. The explanation of its strange appearance I cannot give better than in the words of Professor De Candolle. "The panicle (that is the cluster of flowers) of Rhus Cotinus is almost entirely smooth at the flowering season; after that period all the flower-stalks which bear fruit, continue to remain smooth or scarcely downy; but, on the contrary, on those whose fruit is not formed, and they constitute the greatest number, there appears a great quantity of

scattered hairs, which give them a shaggy aspect, on which account gardeners have named the plant the Wig Tree; it is probable that this excessive production of hairs is caused by the sap, which was destined to nourish the fruit, not having any employment in those stalks the fruit of which is not formed, and expending itself in the production of this extraordinary quantity of hair."

The genera hitherto mentioned are upon the whole better adapted to give a student a correct notion of the character of the Rose tribe, than the *Rose* itself. It is now necessary that we should examine this charming flower, in the construction of which you will find as much to admire as in its external attractions. The leaves and stems of Roses are sufficiently like those of the Bramble, to render it unnecessary for me to insist upon any peculiarities in those parts. In the flower much seems to differ, although in reality but little essential difference exists between Roses and other Rosaceous plants. It has a calyx of five divisions, some of which are very like small leaves. To these succeed five petals; and within the latter is a great number of stamens, which grow from the side of the calyx. You will not at first sight perceive any pistils: in the centre, indeed, is a tuft of stigmas, but no ovaries are visible; upon further search, however, you may discover, especially if you press the flower forcibly between the finger and thumb, that the styles project through the neck of an oblong green body, which being below and on the outside of the calyx, looks like an inferior

ovary. If you split the flower perpendicularly, you will then perceive that this body, that looks like an inferior ovary, is in reality the tube of the calyx, which is contracted at the place where the stamens originate, into a narrow orifice, through which the tops of the styles protrude; and that the ovaries are included within that tube, forming as usual the bottom of the styles. Perhaps you will gain a clearer notion of this if you suppose that part of the tube of the calyx of the Strawberry, which is included between the letters *b* and *c* in the accompanying figure (*fig.* 2.) to be lengthened very much, while all the other parts retain their size and position; in that case the carpels, with their receptacle, might become much shorter than the tube of the calyx, instead of being longer, and if the latter were contracted at its mouth, no part of the carpels would be visible except the tops of the styles and the stigmas. The ripe fruit, or hep of the Rose, is nothing more than the same tube of the calyx turned red and fleshy, the sepals, and petals, and stamens having dropped off; in its inside will be found the carpels changed to bony grains, covered with coarse stiff hairs.

Thus are constructed those plants which most exactly belong to the Rose tribe. They are all harmless, and when they are sufficiently agreeable to the palate, eatable; very often, however, their juice is so very austere and astringent that no use can be made of them except in medicine. They have sometimes been employed in domestic medicine, especially

Herb Bennet, the roots of which have been found by some physicians as valuable in the cure of fevers as the Jesuit's bark itself.

Very nearly allied to the Rose tribe are two other sets of plants, which by some are reckoned mere subdivisions of it, though by others they have been considered distinct natural orders. We need not trouble ourselves with that inquiry; I dare say you will prefer to know what they are, and how they are characterized.

The first of these is the *Apple tribe*, to which belong all those plants which agree with the Rose tribe in every thing but the carpels being distinct and superior; in lieu of which they have the carpels united and adhering to the tube of the calyx. Take an Apple tree in flower, as an example of this. It is a plant with leaves having netted veins, and stipules at their base. The calyx has five divisions, the petals are five, and there is a great many stamens growing out of the sides of the calyx. In the centre you will find five styles; but their ovaries, instead of being merely enclosed within the tube of the calyx, adhere and form one body with it. It is this circumstance that gives rise to all the difference that you find in the fruit itself. An apple is a large fleshy body having at one end what is called an eye; which is in reality the remains of the calyx surrounding the withered stamens. The principal part of the flesh is the tube of the calyx, but the central part is the carpels, also grown fleshy, and at this period undistinguishable from the calyx itself; that their number

was five is shewn by the five cavities in the centre of the fruit, each of which contains one or two seeds. Now it is obvious, if this description be carefully considered, that the fruit is the only thing by which the Apple is known from a Rosaceous plant. The same kind of structure is found in the *Pear*, and the *Quince*, and the *Mountain Ash*. In the *Medlar* and the *Hawthorn* it seems as if the fruit contained two or three stones instead of the open cavities of the Apple; but in reality the only peculiarity in those fruits consists in the lining of their cavities being bony instead of thin and papery, as you may easily satisfy yourself by looking at their flowers. All the plants of this tribe are as harmless as the genuine species of the Rose tribe itself.

The other group to which I have referred is the *Almond tribe*. This is less different in structure than the Apple tribe, but more dissimilar in sensible properties. It consists of species which have all the essential parts of structure of a common Rosaceous plant, but which bear fruit like that of a Plum. The Plum-tree itself, for example, has leaves with netted veins and stipules at their base; a calyx of five parts; five petals; and a great number of stamens arising out of the sides of the calyx. But in room of many carpels, there is only one, and that one changes to a fleshy body, containing one single seed, enclosed in a hard stone. The hard stone is the lining of the cell of the carpel, separated from the fleshy rind that is on the outside. This kind of fruit is called a DRUPE. What is found in the Plum exists

equally, and but little modified, in the *Apricot*, *Peach*, *Nectarine*, *Almond*, and *Cherry*, all which are species of the Almond tribe. They would not perhaps be separated by Botanists into a distinct natural order, upon so slight a character, as the fruit being a Drupe, if that circumstance were not accompanied by a difference in the qualities of such plants. Instead of being perfectly wholesome, they are in many cases highly poisonous, as the *Common Laurel* (Prunus Laurocerasus), the leaves of which yield the dangerous infusion called laurel-water. This is owing to their yielding a volatile principle called Prussic acid, which in its concentrated state is one of the most dangerous of poisons. It is it which gives the well known flavour to Almonds, Ratafia, and the liqueurs called Maraschino, Kirschenwasser, and Mandel amara, and which is so often employed to mix with creams. Do not however suppose, that on this account there is any real danger in eating the fruit of Cherries, Plums, Peaches, and the like; in those fruits the prussic acid exists in such very minute quantity, as to be incapable of producing any deleterious effects. Nature has provided amply against the ill effects of such an insidious enemy, by rendering its presence instantly perceptible by an intensity of flavour that cannot be mistaken. There are those, indeed, who have condemned the whole tribe for the qualities of a few, and who have gone so far as to assert, that the dried leaves of the common Sloe were poisonous. It is not probable that the green leaves of that plant would produce any seriously bad effect; and it is certain that when dried

they would lose what little poison they may have possessed when green, because the prussic acid principle is so volatile as to be immediately dispersed by the mere exposure of the leaves to heat.

Plants of the Almond tribe have also this peculiarity in which they differ from the Roses; their bark yields gum; as you may see by the cracked branches of diseased Cherry and Peach trees. Like the Roses themselves, they have also a great deal of astringency; and their bark has been used in the cure of agues and fevers with considerable success.

If you analyze the characters of these three orders, you will find that their differences may be expressed thus:—

Ovary superior	.	{ many Carpels.—*The Rose Tribe.* one Carpel.—*The Almond Tribe.*
Ovary inferior	. . .	*The Apple Tribe.*

The woody species of these three natural orders are objects of such universal cultivation, Roses for their odour and beauty, Peaches, Apples, &c. for their utility as fruit-trees, that I cannot do better than explain to you the principles upon which the operations of budding and grafting, by which they are propagated, are conducted. If you do not care for multiplying Apples and Pears, I dare say you would at least be amused in making one kind of Rose grow upon another, and in converting the wild Briars of the neighbouring hedges into objects of greater beauty.

The gardener's operations of budding and grafting, depend for success upon the fact, that a portion of

one tree will grow upon another if skilfully applied to it. There are those who have believed that a piece of one plant would grow upon *any* other; and that Roses might be budded upon Black Currant bushes or Pomegranates; this, however, is untrue. It is a certain fact, that one tree will grow upon another only when the two are *very closely* allied in structure. Thus a Pear will grow upon a Medlar or a Mountain Ash, but not so well as on some other Pear; a Rose will grow upon any other Rose, but not upon an Apple. This is a fundamental rule.

In the next place, the stems of all plants consist of buds, and of the part that bears them; the latter has no power of growing without the former, but the former can grow without the latter. For example, if I plant a portion of a stem deprived of its buds, it will die, notwithstanding all the care I can take to preserve it; but if I take the bud of a plant without any stem, and place it in earth, it will grow, if due precautions are employed; this shews, that the property of increasing a plant resides in the buds exclusively. It is not, however, *necessary* to separate the bud from the stem; on the contrary, the two aken together are frequently employed, when they are called cuttings; if the bud alone is employed, it retains its own name. These are the next points to attend to.

Thirdly, both cuttings and buds will grow in other media than earth, as for instance, in water, or damp moss, or in any material which is capable of furnishing them with a constant supply of moisture and

food. Nothing is more proper to furnish this than the stem of a tree in which the sap is in motion; because sap is moist, and at the same time, is the food of plants ready prepared for them to consume it.

Hence, if a cutting, or a bud be carefully planted in the stem of a tree, they will grow; their roots will be insinuated beneath the bark, and form new wood, and so strong an adhesion will take place between them, that no force can afterwards separate them.

Thus, if you would bud one plant upon another, the plan is this; it must be done when the sap is most in motion, and when the bark can be easily divided from the wood; you then cut a narrow slice off the branch which you wish to increase, taking care that it has a well-formed bud upon it; with a smart jerk, the small quantity of wood that adheres to the slice may be taken off, leaving nothing but the bud attached to the bark. Then, with a sharp knife, an incision must be made lengthwise through the bark of the plant in which your bud is to grow, and at the upper end of that incision, a transverse cut, so that the two will together form the letter T. The bark is next to be lifted up on each side of the longitudinal incision, and the bud, with its adhering bark, is to be slipped in. If the whole is then bound up with worsted or matting, a union will take place between the bud and the branch into which it is inserted, and a new plant will be created.

If you would graft one plant on another, you must follow a different plan; for grafting is effected with cuttings, and cuttings cannot be so conveniently slipped

beneath bark, except at one end. There are many ways of performing the operation of grafting, one of which is the following:—You cut off the upper end of the branch on which you wish to insert a cutting; and you then pare the end of the branch flat, equally on both sides, till it resembles a long wedge. This done, you slit the lower end of the cutting, and pare away its wood to two flat faces, which correspond with the faces of the branch on which it is to be made to grow. You are then to fit the cutting accurately to the branch, taking care that the bark of both touches exactly, and if they are bound together with worsted or matting, as before, the operation is completed. As however by this method the cutting is less readily supplied with sap than in the case of buds inserted beneath the bark, it might perish before any union between itself and the branch could take place; to prevent this, it is usual to surround it with a thick coating of clay, which adheres to the surface of both branch and cutting, prevents evaporation, and also keeps the two more firmly applied to each other.

These are the simple means by which such important operations as the multiplication of rare and valuable plants, by making pieces of them grow upon those which are worthless, are performed. If we possessed no such power, it would be almost useless to occupy ourselves with improving the quality of fruit trees, for we should be unable to perpetuate them.

Here I would recommend you to pause for the present; and when what relates to the Rose Tribe is fully

mastered, to proceed to the second half of this long letter.

There is, perhaps, no natural order which is more easily recognized than the *Pea tribe*, nor one in which greater interest is usually taken; it is so rich in plants useful for food, as the *Pea*, *Bean*, &c. or for forage, as *Clover* and *Lucerne*; or dyes, as *Indigo* and *Logwood*; or timber, as *Brazilwood*, *Rosewood*, and the *American Locust Trees*; or medicine, as the *Senna* plant; or gums, as the *Arabian Acacia*; and attractive for their beauty, as *Robinias*, *Laburnums*, *Bladder Sennas*, and the noble tropical species of Butea, Jonesia, and Bauhinia, that it would be difficult to point out any group of plants in which there is more to instruct and delight the student.

The Pea tribe is so vast that the last enumeration of the species by Professor De Candolle, occupies between four and five hundred closely printed octavo pages. It will, therefore, be impossible for me to do more than give you a sketch of the general character by which this extensive assemblage is held together. *It consists of plants bearing pods*, formed upon the same plan as that of the Pea, and called LEGUMES; this is the great essential character, and the only one which is universal. It is, therefore, necessary to teach you, in the first instance, how you are to know a Legume with certainty. Imagine to yourself a carpel which grows long and flat, and usually contains several seeds, and which, when ripe, separates into two valves or halves; recollect, also, that the seeds all grow to one angle only of the inside of the carpel;

in a word, study a Pea-pod, and you will know what a legume is. You must not expect, however, that it will always be exactly like a Pea-pod; on the contrary, it is longer or shorter, larger or smaller, harder, thinner, or differently coloured, contains more or fewer seeds; or, in short, may vary in many ways: but it will always be formed upon the same plan. This is what you are to take as the character which holds together all the subdivisions of the Pea tribe.

The most striking feature in these plants, next to the legume, is the singular arrangement of the petals, which gives to a very large proportion of the whole natural order the name of *Papilionaceous*, or Butterfly-flowered. By this title, we distinguish the first division of the Pea tribe; as an example of which a common Pea flower would answer the purpose. I however, send you a sprig of the *narrow-leaved Restharrow* (Ononis angustifolia, Plate VIII. 2.). It has leaves the veins of which are at first sight ribbed rather than netted; you will, however, find, that the netted structure is what they really possess; at their base is a pair of stipules as in the Roses and their allies. The calyx is formed of five sepals, that unite in a short tube (*figs.* 2. & 3. *a.*). The corolla consists of five petals, one of which is larger, and stands at the back of all the others, wrapping them up before the flower expands (*figs.* 2. & 3. *b.*); this is the *standard*, or vexillum. In front of the standard are two smaller petals (*figs.* 2. & 3. *c.*), which are placed nearly parallel with each other, converging a little at the point; they are the *wings*, or alæ, and

are carefully folded over a boat-shaped curved part of the corolla, which is placed in front of all the rest; this part, called the *keel*, or carina (*figs.* 2. & 3. *d.*), is formed of two petals, which are slightly united at their lower edge, as you may discern by pulling the keel away from the calyx, when you will see their two stalks (*fig.* 4.); the corolla is, therefore, formed of the same number of parts as the calyx, but so masqued that you would not have at first suspected such a thing. This is what is called a butterfly-shaped flower; some poetical Botanists having fancied a resemblance between the expanded flower and a butterfly at rest.

Let us miss the stamens for the present, and pass on to the ovary (*fig.* 6.), which is a tapering green hairy part, gradually narrowing into a style which ends in a minute stigma. Its legume is a short flat body (*fig.* 7.), to which the withered style sticks. When ripe it splits into two halves, to each of which a seed or two (*fig.* 8.) is attached.

Papilionaceous flowers may be themselves separated into those which have their *stamens united*, and those which have their *stamens separate*. To the first belongs the Restharrow; which has nine of the stamens joined together about half-way (*fig.* 5.), and a tenth a little separated from the others. It is here, also, that are found nearly all those species of the Pea tribe with which you are likely to be acquainted. *Peas*, *Beans*, *Vetches*, *Clover*, *Trefoil*, and *Lucerne*, are known to every body; all these you can easily procure for examination. *Laburnum*, too, with its branches of

golden flowers, *Furze* (Ulex europæus), and *Broom* (Spartium scoparium), which are almost too beautiful to be inhabitants of northern countries, *French Honeysuckles* (Hedysarum coronarium), with their crimson clusters; and the singular *Bladder Senna* (Colutea arborescens), the pods of which explode with a loud report when smartly pressed between the fingers, are species of Papilionaceous plants of frequent occurrence: all which it would be well for you to study, and compare with the characters you will find in systematic works. *Indigo* (Indigofera tinctoria), which has proved so valuable as a dye, you will not meet with easily in this country; but you may procure the *Liquorice* plant (Glycyrrhiza glabra), the roots of which are so exceedingly sweet.

Ths second group of Papilionaceous flowers, with the stamens separate, comprehends the chief part of the showy New Holland shrubs, called *Pultenæa*, *Gompholobium*, *Daviesia*, &c., but not a single European species, nor any thing worth pointing out for its utility.

The next division of the Pea tribe consists of the *Cassias* and their allies, which are remarkable for *not* having Papilionaceous flowers;—in place of which they have their petals spreading equally round the pistil, as in other plants; their stamens are also usually spreading and separate. The irregularity of growth which causes the Papilionaceous appearance in the last division, also exists among these plants, so that you will generally find them with some of the petals or the stamens larger than the remainder.

Few of them are ever seen in this country, but in foreign climes they are exceedingly abundant. *Cassias* themselves, some of which yield the well-known medicine called *Senna*, are common in all parts of the tropics; the *Logwood*, the *Tamarind*, the *Barbadoes flower-fence* (Poinciana), the brilliancy of whose orange-coloured flowers is too intense to be steadily looked upon, the fragrant *Asoca Tree* of India (Jonesia), which Botanists have consecrated as a floral monument to one of the most learned of Oriental scholars, and the *Judas Tree* (Cercis siliquastrum), which makes all Turkey put on a violet robe, in its flowering season, belong to genera of the Cassia division. To these may be added, as other remarkable plants, the *horrid Acacias* (Gleditschias), whose trunks are covered with stiff branching spines, and which are so very remarkable in cold countries for the airy Mimosa-like appearance of their foliage; the *Carob Tree*, or *Algaroba* (Ceratonia Siliqua), the sweet pods of which are used for food in Spain, and whose seeds are supposed to have been the original *carat* weight of the goldsmiths, the *Tonga-bean* plant (Dipterix odorata), with the perfume of whose seeds you are doubtless acquainted; and, finally, Bauhinias, those large climbers which hang among the trees of tropical forests, like enormous cables, twisting round trunks and branches till they utterly destroy them.

The third division of the Pea tribe is that of *Mimosas*. Figure to yourself a plant with the sepals and petals of the Cassia group, only so small as

scarcely to be visible; the flowers growing in compact clusters; and the stamens not only very numerous, but so long and slender and delicate as to resemble silken threads tipped with very little anthers. If you can imagine such a structure you will have a sufficiently correct idea of the Mimosa division, the beauty of which, on account of the multitude of flowers they bear, and the gay colours in which they are invested, is of so peculiar an appearance, that one of them, a nearly hardy tree (Acacia Julibrissin), is actually called by the Persians, in whose country it grows, the *Gul.ebruschim*, or *Rose of Silk*. Here belong the curious *Sensitive plants* (Mimosa), whose many parted leaves shrink from the touch of the very wind that blows upon them, which close up and appear to go to sleep at night, and which seem as if struck with sudden death if they receive any rude shock; of these plants the balls of flowers are peach-coloured. To the genus *Acacia*, of which great numbers are found in New Holland, where they are called *Wattle Trees*, also belong the spiny *gum* trees of Arabia and Senegal; the greater part of the species have yellow flowers, and many of them broad dilated leaf-stalks, in room of the many-parted leaves which they bear when young.

The differences of these three divisions of the Pea tribe may be expressed thus:—

Flowers papilionaceous . . *Papilionaceous Plants.*

Flowers not papilionaceous { Stamens few—*Cassias.* / Stamens numerous—*Mimosas.*

With this I take my leave of you for the present, promising that my next letter shall be shorter, if it is not more interesting.

EXPLANATION OF PLATE VIII.

1. The Rose Tribe.—1. A leaf, a few flowers, and fruit of a *Strawberry Plant; a* stipules.—2. The calyx and pistil cut through to shew the origin of the stamens; *a* sepals, *b—c* tube of the calyx.—3. A stamen seen in front.—4. The same seen from the back.—5. A carpel; *a* the ovary, *b* the style, *c* the stigma.—6. A fruit cut through perpendicularly to shew the fleshy receptacle, and the grains, *a*, sticking to it. Compare this with fig. 2.—7. A ripe grain.—8. The same cut through to shew the seed.—9. A seed extracted from the grain.—10. An embryo, with the radicle at the upper end.

II. The Pea Tribe.—1. A piece of the *Narrow-leaved Rest-harrow* (Ononis angustifolia).—2. A flower seen from the side; *a* sepals, *b* standard, *c* wings, *d* keel.—3. The same flower seen in front; the letters refer to the same parts.—4. A keel apart, shewing the two stalks of the petals which form it.—5. Stamens.—6. A pistil.—7. A ripe legume, with the calyx adhering to it.—8. A seed; *a* the cord by which it was attached to the receptacle.—9. The same cut open, shewing the position of the embryo, of which one cotyledon only is visible.

LETTER IX.

THE PROTEA TRIBE—THE AMARANTH TRIBE.

(Plate IX.)

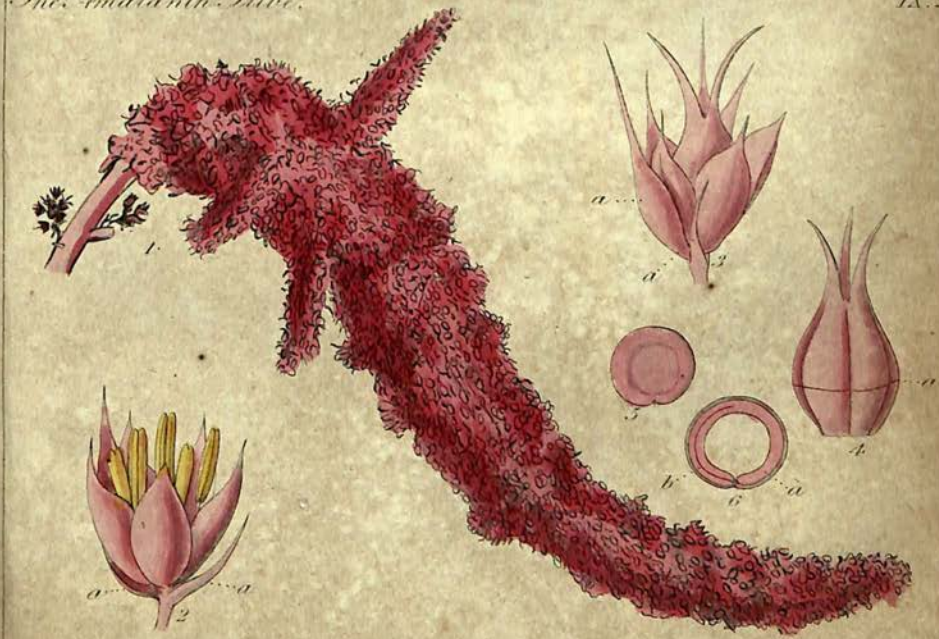
If you cast your eye back over the various tribes we have passed in review, you will remark that they all agree in one circumstance, however different they may be otherwise. They all have both calyx and corolla: that is, two distinct rows of parts on the outside of the stamens; and the petals are never joined together: on this account they are called *Polypetalous*, a name which is made by many Botanists to designate the large portion of the vegetable kingdom to which they belong. By and bye you will learn that another portion of considerable extent is called *Monopetalous*, because the petals are united by their edges into one tube or body; and I have now to explain that a good many natural orders, which have either a calyx without any petals, or no calyx at all, receive the name of *Apetalous*. They are often also called imperfect or *incomplete*, with reference to their want of petals; it is to some of these that I wish next to direct your study.

The first with which we shall begin, is what is called the *Protea tribe*, a group of exotic plants very much cultivated in green-houses for the sake of their beautiful or singular foliage, and the great masses of

The Protea Tribe. IX. 1.

Sir. Joseph Banks's Grevillea.

The Amaranth Tribe. IX. 2.



Love lies bleeding.

minute flowers which are borne by some of them; but totally unknown in a wild state in Europe. It would be easy to name some kind with which you might make a personal acquaintance, by inquiring of your gardener after *Hakeas*, or *Persoonias*; or *Grevilleas*; but you will probably prefer that I should in this instance send you a copy of a drawing by Mr. Ferdinand Bauer of one of the handsomest of the kind found by him in New Holland, and named *Sir Joseph Banks's Grevillea* (Grevillea Banksii).

The leaves of this plant, like those of the whole tribe, are exceedingly dry and hard; they are divided into many narrow lobes, but this is not by any means universally the case; on the contrary, they are frequently perfectly simple and undivided. The calyx (Plate IX. 1.) is a long narrow tube, slit on one side (*fig.* 1*.), and turned down at the point so as to give the border a very oblique and bagged appearance; by disturbing the bag with the point of a pin it will divide into four concave lobes, each of which (*fig.* 2.) allows an anther to nestle within its cavity. The pistil consists of a long hard style, rather abruptly bent above the middle, terminated by a thickened one-sided stigma (*fig.* 1**. & 1* *b*.), and arising from a hairy one-celled ovary having a jagged scale at its base (*fig.* 4. *a*.). This scale is one of the things which used to be called *nectary*, under the idea that it was formed for the purpose of secreting honey or nectar; but that term is now abandoned. The style is so long that you would wonder how it could ever have been confined within the calyx; and the stigma

is so far off the anthers that you will find it yet more difficult to imagine how the pollen is to touch it; both these are arranged in a very simple way. Before the flower opens, the stigma, as the style lengthens, is pressed against the point of the calyx; but here the sepals adhere so firmly that they will not open; the consequence of which is that as the style goes on lengthening it gradually takes a bend upwards, and pressing forcibly against the upper side of the calyx, splits it open, by separating the two sepals upon whose line of union it is forced. The pressure of the stigma upon the point of the calyx causes the latter to be moulded into a sort of socket, in which the anthers actually lie; so that as soon as the stigma begins to be loosened, by the growth of the style after the latter has slit the calyx, the pollen is gently taken out of the anthers by the cup of the stigma; which, when it finally separates altogether and rises up, carries the pollen away along with it.

In time the calyx falls off, and the ovary grows into a hard dry fruit (*figs.* 5. & 6.), which opens like a legume, and exposes to view a couple of seeds.

Other Proteaceous plants are formed upon a similar plan: their calyx is often separated into four distinct sepals, and then no socket is formed to hold back the stigma; or there are other variations of minor importance, but in the absence of petals, in the origin of stamens from the face of the sepals, and in the peculiar fruit, they all agree.

What causes the most striking difference in their appearance, is the flowers of some growing singly

among the leaves, and of others being collected into compact heads. Those genera which have the latter structure, are the handsomest and most usually cultivated; the Proteas which are found at the Cape of Good Hope, in dry, barren, stony, exposed situations, are most noble looking objects, in consequence of their beautiful feathery flowers being half hidden by large red, or white, or black-edged bracts of the purest colours. Banksias and Dryandras are chiefly valued for their handsome leaves; some of the latter are so fringed with long hairs as to resemble the plumes of birds. They are applied to scarcely any useful purpose; but appear to be perfectly harmless: their seeds are sweet, and are eaten sometimes as nuts, both in Africa and South America; one of them, called *Witteboom* (Protea argentea), is the common fire-wood at the Cape of Good Hope.

But let us leave these showy and useless strangers for a tribe that is known to every one who has a garden. *Love-lies-bleeding* (Amaranthus caudatus), *Prince's Feathers* (Amaranthus), *Globe Amaranths* (Gomphrena globosa), *Tricolors* (Amaranthus tricolor), and *Cockscombs* (Celosia coccinea), have been cultivated as long as gardens have been prized; they form, along with some others of a similar structure, what is called the *Amaranth tribe.* This natural order, like the last, has no corolla. Its calyx consists of five crimson sepals (*figs.* 2. & 3.), of so dry a texture, that you would say they were really dead; these are surrounded by a number of bracts, of the same colour and texture as themselves. It is owing to the dry-

ness and thinness, and usually gay colours of these parts, that Cockscombs and the like owe their glossiness and beauty, and also the property they possess of remaining for months without fading. The remainder of their organs are constructed upon the simplest plan. A few anthers, usually five (*fig.* 2.), and an ovary with two or three styles (*fig.* 4.), having but one cell and one ovule, complete the apparatus by which such a plant is increased. When the fruit is ripe, the shell of the ovary becomes very thin, and bursts in the middle by a horizontal opening (*fig.* 4. *a.*); the seed (*fig.* 5.) is a little flat body, with a slender embryo (*fig.* 6.), coiled round some mealy albumen.

It is difficult to mention an order much more simply constructed than this, and yet how perfectly are all the parts adapted to the end for which they are created. Even a provision for a beautiful appearance is not neglected, for in order to compensate for their smallness, we find the flowers developed in large masses, and aided by multitudes of shining bracts which contribute very essentially to their fine appearance.

With an assurance that these plants are all as harmless as they are beautiful, I take my leave of you till another day.

EXPLANATION OF PLATE IX.

I. The Protea Tribe.—1. A flower of *Sir Joseph Banks's Grevillea*, seen in front, of the natural size.—1*. The same magnified and viewed from the side ; *a* the socket of the calyx, *b* the stigma.—1**. The upper end of the style and the stigma viewed in half profile. 2. The upper end of a sepal, with the anther *a* nestling in it.—3. An anther.—4. An ovary, with the scale, *a*, its base.—5. A ripe fruit, natural size.—6. The same burst open.—7. The seeds taken out, with a moveable partition that separates them just brought into view.—7*. The same magnified.—8. An embryo.—9. The same with the cotyledons divided a little. (All these are after a figure by Mr. Ferdinand Bauer.)

II. The Amaranth Tribe.—1. A bit of the inflorescence of *Love-lies-bleeding*, of the natural size.—2. A calyx containing stamens; *a* bracts.—3. A calyx containing a pistil ; *a* bracts.—4. ripe fruit; *a* the horizontal line where it opens.—5. A seed.—6. The same cut perpendicularly ; *a* the radicle, and *b* the cotyledons of the embryo.

LETTER X.

THE MARVEL OF PERU TRIBE—THE OAK TRIBE—STRUCTURE OF DICOTYLEDONOUS WOOD.

(Plate X.)

So accustomed are people to identify gay colours with the corolla of a flower, that it is always difficult to make them believe the ovary and red striped part of the Marvel of Peru, to be really a calyx. Such, however, is undoubtedly the fact.

The *Marvel of Peru* (Mirabilis Jalapa) is the representative of a *tribe* named after it, belonging, like the subjects of my last letter, to the Apetalous division of Dicotyledonous plants. It has fleshy perennial roots; jointed stems, which perish at the first attack of frost; and broad opposite leaves, with netted veins. Its flowers appear in compact clusters; and are each surrounded at the base by a green involucre, divided into five segments, so as to resemble a calyx, for which it would be certainly mistaken, if it did not sometimes bear two flowers within the same involucre; a kind of structure that never is found in a true calyx.

Each flower consists, firstly, of a funnel-shaped calyx (Plate X. 1. *fig.* 1.), divided at the end into five orange and red plaited lobes, and contracted at

The Marvel of Peru Tribe.

X. 1

Common Marvel of Peru.

The Oak Tribe.

X. 2

Hazel Nut.

the base (*fig.* 1. *a.*) into a roundish fleshy ball; secondly, of five stamens of unequal lengths, arising from below the ovary (*fig.* 3. *a.*), round which they form a fleshy cup, and then adhering to the sides of the calyx; so that they are actually perigynous and hypogynous at the same time.

The ovary (*fig.* 4. *c.*) is a superior body, containing a single ovule, which grows from the bottom of the cavity; it is terminated by a long thread-shaped style, which ends in a cluster of little round warts (*fig.* 3. *b.*), forming a stigma. Thus far the structure is as simple as that of the Amaranth and Protea tribes; nor will it be found more complex in the fruit.

As soon as the flower begins to fade, the roundish fleshy ball at the bottom of the calyx, swells and grows harder, contracting at the top, and in time throwing off the thin and coloured part. At last it acquires a woody texture, shrivels round the veins, and becomes an oblong brown nut (*fig.* 6.), with a little hole at its point (*a.*), where the upper coloured part of the calyx fell off. Upon opening it, you will find the fruit, with a very thin shell, and the remains of the style at the top (*fig.* 7. *c.*). Within it lies a single seed having an embryo (*fig.* 7. *a. b.*), rolled round a quantity of mealy substance, which is the albumen (*d.*).

Such is the character of the natural order that contains the Marvel of Peru, which is by far the most handsome genus it comprehends. Generally, the order consists of obscure weeds, which are rarely

seen in gardens, although they are common enough in tropical countries. It differs obviously from the Protea tribe in the stamens being hypogynous; from the Amaranth tribe in the calyx being all in one piece; and from both in the singular circumstance of the lower part of the calyx becoming hardened and forming a sort of spurious shell to the fruit. This last is the essential character of the Marvel of Peru tribe, or Nyctagineæ; which I only introduce to you as a striking instance, firstly, of the highly coloured condition often assumed by the calyx, and secondly, of the singular manner in which one part is occasionally employed by nature to perform the part of another.

Very different from these, although also belonging to the Apetalous division of Dicotyledonous plants, is that most interesting natural order, which includes the *Oak*, and the *Sweet Chesnut*, the *Beech*, the *Hornbeam*, and the *Hazel*; in short, the larger part of our common European trees. In consequence of its containing the Oak it bears the name of the *Oak tribe*. Until I shall have explained to you the real origin of all the parts you find in these plants, and the singular manner in which they change between the infancy of their flowers, and their old age, you will have had but a feeble idea of the wonderful power the parts of plants possess of assuming unusual forms after they have been once developed. If it be true that flowers are generally seen in a masquerade dress, as some Botanists poetically assert, it certainly is here that their disguise is the most impenetrable.

The *Hazel* is one of the most accessible to you when it is young, and a good illustration of the structure of the others. At the earliest period of the spring you must have remarked the branches of the Hazel loaded with little yellow tails, which swing about as the wind disturbs them, and fill the air with a fine and buoyant powder, the particles of which may be seen glittering in the sunbeams like motes of gold. These tails are called CATKINS (Plate X. 2. *fig.* 1. *a.*), and are composed of a great number of little scales, which are arranged one behind the other with the utmost regularity, as you may easily discover by inspecting them, before they separate. Each scale has on its inner face about eight anthers, that seem to arise out of a two-lobed flat body, which adheres to the scale (*fig.* 2.); no other structure is to be found; apparently neither calyx, nor corolla, nor pistil; nothing but the two-lobed body sticking to the scale and bearing the stamens. Botanists consider the scales bracts, and the two-lobed body a calyx in an imperfect state.

This then is an instance of a simpler kind of organization, than any you have before met with in a flower. It is, however, not quite characteristic of the Oak tribe, for the Hornbeam has no calyx whatever, while the Oak, and the Beech, and the Sweet Chesnut have a much more perfect one than the Hazel.

If the Hazel had none but stamen-bearing flowers, you would never have any nuts in the autumn; for there is nothing in those flowers which could by any

possibility change into a nut. In this plant not only are the stamens and pistils in different flowers, but in different parts of the plant, and organized upon quite a different plan. If you observe attentively those buds of the hazel which grow near the catkins (*fig.* 1. *b. b.*), about the time when the stamens are shedding their pollen, you will perceive some little red threads protruding beyond the points of the buds, and spreading away from the centre; those are the stigmas, and the pistils are enclosed within their scales, where they are safely protected from accident and cold. At the earliest moment when the stigmas can be discovered, let the scales be removed (*fig.* 3.), and you will find the flowers clustered together among a quantity of soft hair, which seems provided as an additional means of shielding them from the weather, and to serve the same purpose as the warm lining of down, which the birds provide for their young when they first break the shell and before they are fledged. Each of these flowers is surrounded by a jagged sort of cup (*fig.* 4. & 5.), which is originally much shorter than they are, but which in time grows considerably longer; that cup is the involucre. The flower itself consists of a jagged superior calyx (*fig.* 5. *a.*); an ovary with two cells and two seeds (*fig.* 6.), and two long thread-shaped crimson stigmas. Thus you see the calyx of the pistil-bearing flower is much more perfect than that of the other kind of flower; but it is still very imperfect.

The pistils and the stamens being thus separated, there would be no chance of the pollen of the one

falling on the stigma of the other, and fertilizing it, unless an unusual quantity of stamens was provided; hence it is that in a fine day in spring the whole air is, as I have just said, so impregnated with particles of pollen, that they cover every thing as with a fine dust.

By degrees, as warm weather advances, the protection of the scales of the bud ceases to be necessary to the young flowers, which swell and burst through them; the involucre daily grows larger; the stigmas having fulfilled their destiny, shrivel up; the ovary enlarges; one of its ovules grows much faster than the other, and gradually presses upon it till it smothers it; the shell hardens, an embryo makes its appearance, and by degrees fills up the cavity; and at last you have a perfect nut, with its husk (*fig.* 8.), or involucre. At the point of the nut is to be seen the remains of the calyx (*fig.* 9. *b.*); but no trace can be found of the cell and ovule which were smothered; so that a one-celled fruit is produced by a two-celled ovary. You will now know why nuts sometimes grow in clusters, and sometimes singly; if cold or accident should destroy any part of the cluster of pistils in the bud, but a very few nuts, perhaps only one, will grow and ripen; but if they are mostly saved, you will then have the large clusters which are so common in seasons which have been preceded by mild springs. The nut itself affords an excellent illustration of the structure of a dicotyledonous embryo; the two great fleshy lobes into which the nut separates when freed from its skin (*fig.* 9. *c.*),

are the cotyledons; the little conical part at one end (*e.*) is the radicle, and the small scale-like body which lies between them in the inside (*d.*) is the plumule, or young stem.

Still more curious than those of the Hazel are the changes that occur during the growth of the fruit of other genera of the Oak tribe. In the *Oak* itself the involucre is formed of a great many rows of scales, which gradually grow larger and harder, and more numerous, and at last become what you call the CUP of the acorn; a part you would never have guessed could have been made out of a number of little leaves, if you had not watched their successive changes. The ovary at first contains three cells, and each cell two young seeds; but in obedience to the constant command of nature, one of the seeds grows faster than the rest, presses upon the other cells and seeds, gradually crushes them, till at last, when the acorn is ripe, all trace of them has disappeared.

In the *Beech*, the involucre originally consists of a vast quantity of little thread-like leaves, which enclose a couple of pistils. These leaves gradually grow together, and over the pistils, so as to form a prickly hollow case, which completely encloses the nuts; at last, the case rends open spontaneously into three or four woody pieces, and makes room for the nuts, or *mast*, to fall out. As in the Oak, one of the ovules destroys all the others, so that out of six young seeds, but one is found in the ripe nut; here, however, you may generally find the five that have

perished remaining like little brown specks, sticking to the top of the cell of the nut.

In the *Sweet Chesnut*, alterations in character, and the destruction of one thing by another are carried still further. In that plant, the involucre, which, when full-grown, is a hollow case, covered over with rigid spines, was in the beginning a number of little leaves which gradually grew together as in the Beech; they kept acquiring with their age a greater degree of rigidity; their veins separated, and formed clusters of spines, till at last the whole surface of the husk was covered with little spiny stars; each star was in the beginning a leaf, and its rays the veins of the leaf. The pistils each contained six or seven cells, with a couple of ovules in each; yet the ripe nut has only one seed: so that in the course of the growth of a chesnut no fewer than six cells, and thirteen ovules are destroyed by the seed which actually grows.

I feel sure you will now agree with me, that if any plants can be said to exhibit themselves in a masquerade dress, these are they; for without this explanation, who could have supposed that the husk of the filbert, of the beech, and of the chesnut, were all of the same nature, and constructed upon the same plan as the cup of the acorn; and especially, who could have supposed that the chesnut, with its single seed, could ever have originated from an ovary of seven cells and fourteen ovules.

It is among these trees that you will find the best specimens of the Exogenous structure of the wood of

Dicotyledonous plants, a subject upon which I as yet have said almost nothing. Get a branch of Hazel, Beech or Oak, and divide it horizontally, so as to have a view of the whole of the inside from one side to the other, the section forming a circle which is bounded by the bark. Let the section be rendered smooth by a sharp knife or a plane, so that all the parts may be distinctly seen; you will then remark in the centre a pale roundish spot, which a glass will shew to be formed of a soft spongy substance: it is the PITH, a cellular provision of nature for the support of the young buds when they are too weak to obtain food from more distant sources. Next the pith follow several rings of WOOD, each of which is composed of an infinite number of tubes, and was the produce of one year's growth, so that the number of the rings tells you the number of years the branch has been in acquiring its present size; the most external of the rings is the youngest, and also the palest, while the most internal or the oldest is of a deep brown colour; the pale is called the SAPWOOD, the brown the HEARTWOOD; the latter, which is much more durable than the former, is filled with a substance of a hardening nature, which was originally formed in the leaves, and which is stored up by Providence in the centre of the stem, where it lies beyond the reach of accident or injury, until old age comes and produces decay; originally the heartwood was sapwood, and that which is sapwood now, would have become heartwood in a few years, if you had not cut off the branch. It is in the sapwood chiefly that the vital

energy of the stem resides, and it is through it that the sap rises in the spring for the supply of the buds and leaves; an Exogenous tree can therefore lose the whole of its inside without suffering much diminution of growth, so long as the sapwood remains uninjured, and this is the reason why trees that are hollow go on growing century after century, just as if their inside were still sound. On the outside of the wood is the bark, which binds up and protects all the other parts, and down which the returning current of sap descends towards the roots.

Next carry your eye attentively over the section, from the bark to the pith, and you will remark that a number of fine pale lines are drawn as it were from one to the other, forming delicate but broken rays; these lines, which are composed of flattened cells, and named MEDULLARY RAYS, are in reality the ends of extremely thin plates connecting the pith and the bark together; they perform an important part in the system of vegetation, for it is they which convey the descending sap from the bark to the centre of the stem; it therefore is they which are the cause of the production of heartwood, and all trees without them must be destitute of it; as is the case with monocotyledonous plants, which are always softest in the centre.

Thus you see the sap, which rises from the roots is carried upwards in the sapwood, down again in the bark, and latterly into the hidden recesses of the trunk, by the medullary rays, all three currents

moving at the same instant, but without the slightest interference with each other.

Can any thing be more admirably adjusted than all this? By means of a system of tubes and cells variously arranged, the whole of the important business of the conveyance of food to the leaves, and of the peculiar properties formed there from the leaves to the centre of the stem, and down to the extremest roots, is carried on in the most certain and effectual manner, even in the loftiest and most gigantic forest trees. Only conceive what a wonderful combination of powers must be provided to enable a tiny leaf, not perhaps half an inch long, on the highest branch of a tree, to procure its food from roots sometimes 250 feet off, or at a distance equal to six thousand times its own length.

But I must not dwell further upon this subject, interesting as it is; to works on Vegetable Physiology you must refer for a full elucidation of all such matters.

Bearing in mind, that the Oak tribe is constantly known by its imperfect apetalous flowers, and its singular involucre, you are in no danger of forgetting it. Formerly, the *Birch* and *Alder*, the *Poplar* and *Willow*, and the *Plane*, were considered as also belonging to it; and the whole were called *Amentaceous*, because of their stamen-bearing flowers being constantly arranged in catkins, or *amenta*, as they are technically designated. But these trees are so extremely dissimilar in other respects, that they now form several independent tribes.

Of the distinctions of these I shall by and bye give you some account; for the present, I must leave you till you have examined for yourself, as you easily may, the highly singular phenomena I have explained to you.

EXPLANATION OF PLATE X.

I. THE MARVEL OF PERU TRIBE.—1. A flower of the *Common Marvel of Peru* (Mirabilis Jalapa); *a* the thickened base of the calyx. —2. The same part magnified, with the upper part of the calyx cut away.—3. The fleshy base of the stamens *a*, from within which rises the thread-shaped style, terminated by the stigma *b*.—4. A perpendicular section of the fleshy base of the stamens and pistil; *a* the base of the separate parts of the filaments; *b* the base of the style; *c* the ovule seen in consequence of a part of the shell of the ovary being cut away.—5. Anthers.—6. A ripe nut; *a* the closed up orifice of the calyx.—7. A perpendicular section of the nut, shewing the fruit standing erect in the inside of the hardened base of the calyx; *c* the base of the style; *a* the radicle, and *b* the cotyledons of the embryo rolled round the mealy albumen *d*.

II. THE OAK TRIBE.—1. A twig of *Hazel* (Corylus Avellana); *a* the stamen-bearing catkins; *b* the buds containing the pistils.—2. A scale of the catkin, shewing the two-lobed body, and the stamens.—3. A cluster of pistils bearing flowers, in a very young state, with only one of the scales by which they are protected remaining.—4. A pistil-bearing flower, inclosed in its involucre.—5. The same cut open; *a* the calyx.—6. An ovary divided perpendicularly; *a* the calyx.—7. The same divided horizontally.—8. A ripe nut in its husk, or involucre.—9. A nut cut through perpendicularly; *a* the remains of style; *b* remains of calyx; *c* cotyledons; *d* plumule; *e* radicle.

LETTER XI.

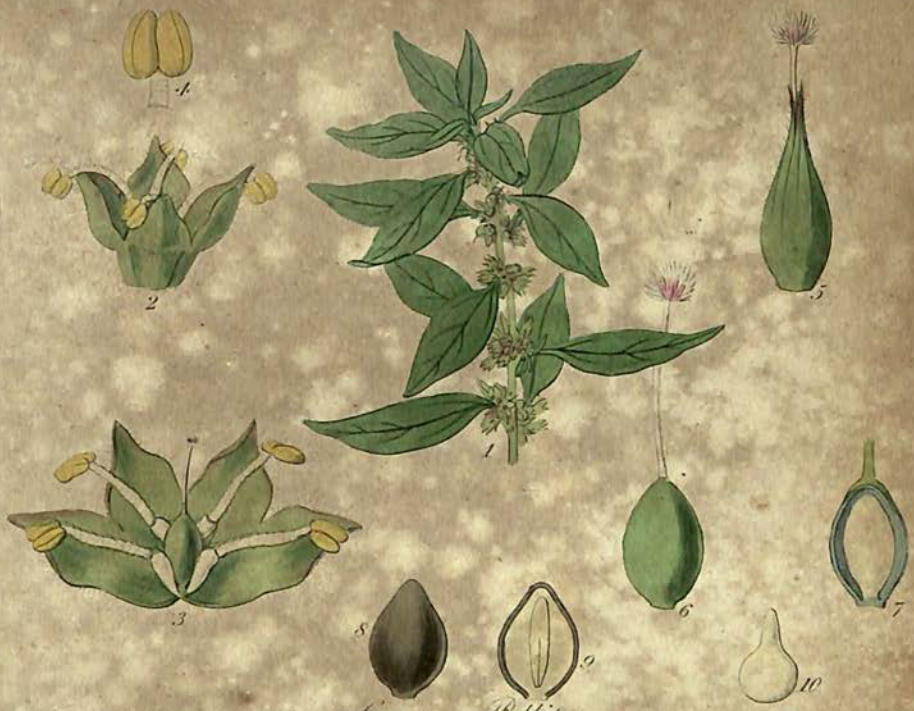
THE NETTLE TRIBE—WOODY FIBRE—THE BREADFRUIT TRIBE—THE WILLOW TRIBE.

(Plate XI.)

THE tribes of Dicotyledonous Plants, with only a calyx to their flower, are far from being exhausted with those we have already seen. On the contrary, there is a great many races, the structure of which is extremely curious. I must, however, be content with selecting three of the commonest for further illustration, and with referring you for a knowledge of the remainder to the systematic works of Botanists.

Let one of these be the *Nettle Tribe;* we will not, however, select the Nettle itself, because of its stings, but begin with a harmless plant called *Common Pellitory* (Parietaria officinalis), which you may find every where on old walls, or in dry waste places. This species grows either prostrate, or erect, is very much branched, has reddish stems and leaves, and clusters of minute reddish-green flowers in the bosom of the leaves (Plate XI. *fig.* 1.). Over all its surface are scattered stiffish hairs, which do not sting, but

The Nettle Tribe. XI. 1.



Common Pellitory.

The Willow Tribe. XI. 2.

Barren & Fertile Willow.

which would if they were stiff enough. At the base of each leaf is a pair of shrivelled brownish stipules.

The flowers of this plant are of three sorts, those which have stamens only, those which have stamens and a pistil, and those which have a pistil only. As the first and second are constructed alike, let us consider them as essentially the same; especially as their pistil is seldom perfect. To each of these flowers there is a calyx with four hairy divisions (*fig.* 2 & 3.); opposite to each division is a stamen; and in the centre is a pistil more or less imperfect. The filaments are worthy of examination; their lower end is firm, smooth and fleshy; but it abruptly alters to a withered shrivelled part, so dissimilar in aspect that you would think it must be a distinct organ. Before the flower opens the shrivelled part is pressed down by the segments of the calyx, which are finally forced asunder by the filaments with force, so that the flower opens with some degree of elasticity; a provision, in all probability, to secure the scattering of the pollen, by which the distant pistils may be reached.

The flowers that contain the pistils are mixed among the others, and like them consist of a calyx with four divisions; but as this contains no stamens, its figure is not roundish, but sharp-pointed, like that of the ovary, to the surface of which it is closely applied. The pistil consists of one ovary containing a single seed (*fig.* 7.), of a thread-like style, and of a pin-headed stigma, the little fringes of which

spread in all directions, and are admirably contrived to catch the grains of pollen floating in the air.

The fruit is an oval shining blackish lenticular grain (*fig.* 8.), which contains a single seed, with an inverted embryo lying in the midst of fleshy albumen (*fig.* 9.).

Such is essentially the manner in which all the remainder of the Nettle tribe is organized. *Pistils and stamens in different flowers, leaves covered with rough or stinging hairs, elastic stamens, and lenticular grains,* are common to them all.

Nettles, which are so remarkable for the intolerable pain, and even the sometimes highly dangerous effects caused by their stinging hairs, differ from Pellitory chiefly in their pistil-bearing flowers having a calyx of two sepals.

Hops have not only a twining stem, and their pistil-bearing flowers collected in leafy heads, but are also known by having five stamens in each sterile flower, and the pistils and stamens on different plants.

Finally, *Hemp,* which also belongs to the Nettle tribe, has the calyx of the pistil-bearing flowers slit on one side, two unequal styles, and five stamens in the sterile flowers. The peculiar tenacity of the stems of Hemp is not uncommon in other plants of the same natural order, and may even be considered characteristic of it.

Considering the many important purposes to which the Hemp is applied, and the prodigious strength that it possesses when twisted into ropes, you will probably be curious to know something of

the exact nature of the part which is capable of being converted to these great purposes. In that case you must have recourse to your microscope; beneath which you may place a little tow, the threads of which are separated, and float in water. At first sight, with a weak magnifying-glass, you will discern no distinct organization in these threads; they will look like dark lines of about the thickness of a fine human hair; but if you bruise them and tear them about in the water with the point of a couple of needles, you will in time succeed in separating each of the threads into a very considerable number of exceedingly fine parts, which you may discern, by increasing the magnifying power of your microscope, to be transparent tubes, composed of a tough membrane, and tapering to each extremity like bristles; these are glued together in bundles which constitute the finest threads that are visible to the naked eye. Their business is not simply to grow in the inside of a plant, in order that man may pull them out and apply them to his own purposes; they have a far higher and more important office to fulfil. It is they which give strength and toughness to every part, and which enable the stem and the leaf to wave about in the breeze or to bend before the storm without breaking; they are placed as a sort of sheath all round such tender parts as the spiral vessels, which are enabled within their safeguard to perform their delicate functions with certainty and security; and, finally, it is they which act as so many water-pipes to convey the fluids of plants with rapidity from one part to ano-

ther; up the wood, along the veins of the leaves to their extremest points, back again into the stem, and down the bark towards the roots. When plants have no woody fibre, they are universally so delicate and weak as to be unable either to raise themselves in the air, or to withstand any violence, as we see in mosses, lichens, mushrooms, and such plants.

You will probably be surprised when I tell you that the *Fig Tree* is so nearly the same in structure as the Nettle, that many Botanists consider it to belong to the same tribe; and you may possibly be tempted to exclaim with some who have not considered the subject very attentively, "How absurd to place the Nettle and the Fig together in the same natural group!" *I* must admit that this does appear strange until the reason is pointed out; and I trust *you* will admit that itis clearly right when the reason shall have been explained to you.

Let us then see what a Fig Tree is. It is an Exogenous plant with leaves covered with very stiff short hairs, and with a pair of stipules at their base; so is a Nettle. It has flowers with stamens and pistils separate: so has a Nettle; its flowers have no corolla, and the pistil is a little simple body, which changes, when ripe, to a very small flat grain; all which is exactly what we find in the Nettle. In the essential parts of their structure the two plants then are alike. But where are the flowers of the Fig, you will inquire; you can see nothing but a thick oval green body, which you know will turn to fruit, and which therefore ought to be the flower; here, however, you must

again be prepared to meet with natural wonders. The thick oval green body is a hollow box, or receptacle; within it in darkness and obscurity are reared the flowers, which, like the beggars' children in the caverns among the fortifications of Lille, are so deformed and pallid as hardly to be recognised. Cut a young fig open; the whole of its inside is bristling with sterile and fertile flowers, the former having five stamens, and the latter a jagged calyx, with a little white pistil sticking up in the midst of it. This pistil, when ripe, becomes a flat round brown grain, which is lost among the pulp of the fleshy and juicy receptacle, where you eat it, and call it a seed.

The difference then between the Nettle and the Fig Tree consists not in the structure of the stem, or of the leaves, or of the calyx, or stamens, or pistils, or fruit properly so called; but in the hollow fleshy receptacle within which the flowers are forced to pass through their different stages. This kind of difference is, however, of a very unimportant kind; and not greater than you find between the Strawberry and the Rose, about whose relation to each other every one is agreed.

For these reasons, both the Fig and the Nettle are by some considered to belong to the same natural order; there is, however, a difference that I have not mentioned, and which is important; the juice of the nettle is watery, while that of the Fig is milky; on which account other Botanists consider the Fig to be the representative of a natural order, distinct from that of the Nettle, but in the closest affinity with it.

To this natural order belong the *Breadfruit tree* (after which it is called the *Breadfruit tribe*), the *Mulberry*, and many other exotic trees. For their milkiness they are all most remarkable; it is usually of a somewhat acrid nature, as you may find in the Fig itself; sometimes is highly poisonous as in the *Upas tree* of Java and some Indian species of Fig; or is again quite harmless and even nutritious in the *Cow tree* of South America, to the trunks of which the Indians repair in the morning with their jugs and pails, just as the milkmaids of Europe to their cows. It is, however, probable that in this instance the milk is harmless only at a certain period of the year, before the venomous principle is formed; for a West Indian plant called Brosimum, the young shoots of which afford a wholesome food for cattle, is very nearly the same as the Cow tree, and its old shoots are poisonous. The Fig itself would not be fit to eat if gathered green, because at that time the fruit abounds in milk; but when it is ripe all the milk has dispersed, and then only it becomes the wholesome fruit with which we are so well acquainted.

Let this be a lesson to you never to judge hastily of the affinities of plants, but to remember that it is structure alone, and not vague external resemblances or differences by which their relations are determined botanically.

The last of the tribes without corolla, which I shall be able to lay before you, is one that is constructed with still more simplicity than the last. They had at least a calyx, but this has neither calyx nor corolla,

nor any sort of covering to the stamens, beyond the scale-like bracts, out of the bosom of which the stamens or the pistils arise. These plants are *Poplars* and *Willows*, which together form the *Willow tribe* (Plate XI. 2.). Their flowers grow in catkins (*figs.* 1 & 4.)—those beautiful silky bodies, glittering as it were with gold and silver, which are hailed by northern nations as the earliest harbingers of spring, and gathered for festivals under the name of *Palms* near London, and of *gostlings* in some part of England. The stamens are upon one plant, the pistils upon another. The former are one, or two, or three, or five, or more, to each bract (*figs.* 2. & 3.); the latter are seated singly within a bract, and consist of an ovary, having one cell with many seeds, and a lobed stigma (*fig.* 5.). The fruit consists of hollow cases, which split into two valves (*fig.* 6.), and discharge a multitude of small seeds, covered with fine hair or wool (*fig.* 7.), like the seeds of the cotton plant. On these downy pinions the seeds will fly to great distances and scatter themselves over the whole face of the country. The Willow is absolutely without any trace of calyx; the Poplar has a sort of membranous cup, which may be considered the rudiment of one.

In taking leave of these imperfectly formed orders, I would recommend you to reduce their characters to an analytical form, in order to see their differences the more distinctly. You may do this in many ways, of which the following will serve as an example.

Two of them have the sepals combined into a tubular calyx, namely, the Protea and Marvel of Peru

tribes; of which the former has hard leaves and stamens placed opposite the sepals, and the latter soft leaves, with the bottom of the calyx forming a bony covering to the ripe fruit.

Two others have their male flowers arranged in catkins, namely the Oak and the Willow tribes, of which the former has closed fruit seated in an involucre or cup, and the latter opening fruit without any involucre.

Finally, the three that are remaining, namely, the Amaranth, Nettle, and Breadfruit tribes, are at once known by the first having smooth leaves, without stipules, while the two last have rough or stinging leaves with stipules.

These peculiarities may be expressed in a tabular form thus :—

- Calyx tubular
  - leaves hard, calyx all dropping off or withering away. — *The Protea tribe.*
  - leaves soft, calyx forming with its base a bony covering to the fruit — *The Marvel of Peru tribe.*
- Calyx not tubular
  - flowers in catkins
    - fruit one-seeded, in an involucre — *The Oak tribe.*
    - fruit many-seeded, without an involucre — *The Willow tribe.*
  - flowers not in catkins
    - leaves smooth, without stipules — *The Amaranth tribe.*
    - leaves rough, or stinging, with stipules
      - juice watery — *The Nettle tribe.*
      - juice milky — *The Breadfruit tribe.*

Our next visit will be to far more beautiful subjects.

EXPLANATION OF PLATE XI.

I. THE NETTLE TRIBE.—1. A piece of *Common Pellitory* (Parietaria officinalis).—2. The calyx of a sterile flower, with the stamens projecting.—3. The same cut open.—4. An anther.—5. A fertile flower.—6. A pistil.—7. An ovary cut through perpendicularly, shewing the position of the ovule.—8. A ripe fruit.—9. The same cut through perpendicularly, shewing the position of the embryo within the albumen.—10. An embryo.

II. THE WILLOW TRIBE.—1. A catkin of sterile flowers of the *Monandrous Willow*.—2. A single sterile flower of the *Yellow Osier* (Salix vitellina), with the gland, *a*, at its base.—3. The same with the bract that belongs to it.—4. A catkin of the fertile flowers of the *Yellow Osier*.—5. The pistil with its gland, *a*, and its bract, *b*.—6. A seed-vessel ejecting the seeds.—7. A seed with its down.—8. A seed without the down.—9. An embryo with the cotyledons separated.

LETTER XII.

THE HEATH TRIBE—THE BINDWEED TRIBE.

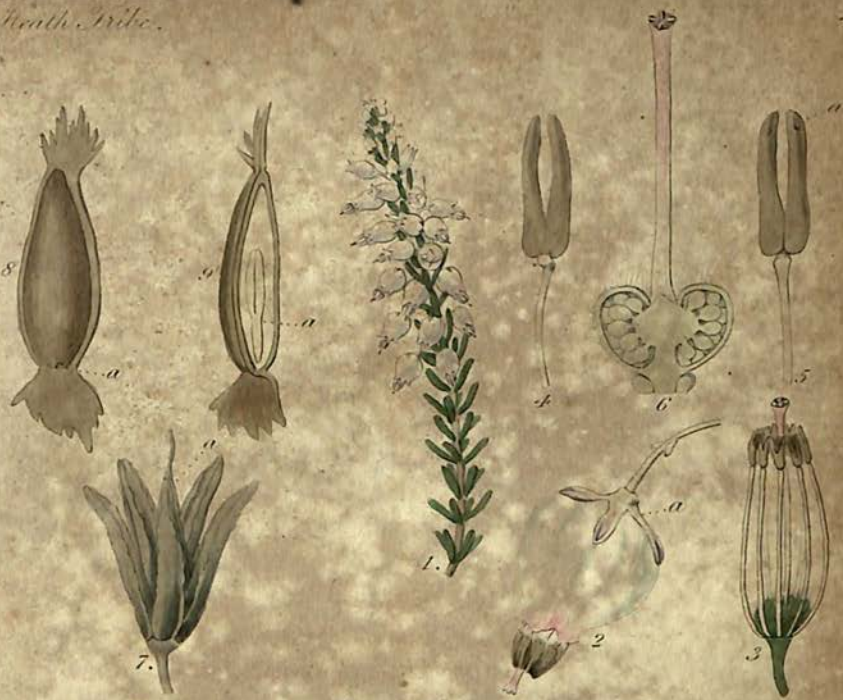
(Plate XII.)

Let me now introduce you to an extremely beautiful set of plants, in which you will find nothing but the most charming colours, set off by so clear a complexion, and such perfect forms, that there is little comparable to them in the whole vegetable kingdom.

Very different from the tribes we have lately seen, so far are they from wanting a corolla that they possess that part in a most highly expanded state; not, however, consisting of several distinct petals, as in all the natural orders we at first examined, but having the petals grown together into a cup or bell or hollow body of some kind, and only separate at their upper ends. These corollas are technically named *monopetalous*, or one-petaled; a very bad designation because the corolla consists in reality of many petals in a united state; but the word was invented when the real nature of such a corolla was unknown, and custom has established what error first promulgated. It is to the various tribes of *Monopetalous Dicotelydons* that we are now to direct our attention.

The *Heath tribe*, which is what I at first alluded to, stands pre-eminent among such plants for its love-

The Heath Tribe. XII. 1.



Hispid Heath.

The Bind weed Tribe. XII. 2.

Dwarf Convolvulus.

liness; and it is very easily known. We will say nothing about its leaves, firstly, because they are variable in appearance; and, secondly, because it is now time we should leave off testing the Dicotyledonous character of a plant at every step; for you must by this time have begun to recognize, with certainty, the features of that primary class, without attention to its technical distinctions. It is in the flowers that the great peculiarities of the tribe are conspicuous. Let us take any Heath for an examination; that which I have at hand is the "Hispid" (Erica hispida), so called on account of the little stiffish hairs with which it is covered on every part. Like nearly the whole of the genus, it is a native of the Cape of Good Hope, where extensive tracts are covered with countless species of all manner of forms and colours. The Hispid Heath has a calyx of four sepals (Plate XII. 1. *fig.* 2. *a.*); and a corolla looking like a hollow globe, with four short teeth at one end; it is of the clearest pink; you may see its veins through the skin, so transparent is every part; and their arrangement will reveal to you the fact of this hollow globe being in reality composed of four petals, so completely united at their edges that nothing but their points is to be distinguished.

Arising from beneath the ovary, and perfectly separate from the corolla, are eight stamens (*fig.* 3.), each of which has a slender filament, and a singular purple anther, with two distinct lobes, shaped like the two prongs of a fork, and opening by a hole at their upper end. This character of holes in the end of the

anther is one of those that are essential to the Heath tribe.

The ovary (*fig.* 6.) is a hairy body containing four cells and a great many ovules; it is terminated by a style having a flat purple stigma, with four little projections on it, corresponding with the number of cells in the ovary. This in time changes to a dry fruit that bursts into valves, for the escape of a countless multitude of seeds as fine as grains of sand, they are frequently terminated by delicate crests or wings of different figures (*figs.* 8. & 9.), and are beautiful microscopic objects.

Now in this description you are to consider the *hypogynous stamens, and the anthers with pores in them,* as the most essential characters of the natural order, and they will, in fact, enable you to distinguish it from all others. It is principally in the breadth of the leaves, in the size and form of the flowers, in the texture of the fruit, and in the number of divisions of the corolla and stamens that the genera vary: they all agree in those common characters.

For instance, the *Arbutus* is like a Heath, but it has broad leaves, ten stamens, and fleshy fruit, which gives rise to its common name of the *Strawberry tree,* and which renders it so noble an ornament of the romantic waters of Killarney.

Andromeda again, with her countless blushing or snow-white flowers, and glossy or powdery evergreen leaves, is like the Arbutus, only the fruit is a dry capsule, opening by valves.

Rhododendron and *Azalea,* on the contrary, have

corollas that spread open at the mouth, with unequal divisions, and with stamens bent towards one side; while *Kalmia* has cup-shaped corollas with ten little niches in which the anthers are nipped up, so that when the flower expands, the filaments are all curved downwards away from the pistil, as if the corolla was unwilling to allow them to touch it; but stir the filament with a pin, at the time when the anther is ready to shed its pollen, and in an instant the stamen starts up, and approaches the anther to the stigma.

All these plants are so well known, from being the pride of the American garden, that I have only to name them to recall them to your memory. Considering how very handsome they are, and how innocent is their aspect, you would scarcely suppose that venom lurked beneath their charms; they will, however, serve as an instance of how little you may trust to appearances, even among flowers; for both the Rhododendron, the Kalmia, and the Andromeda, have not only noxious leaves and branches, but their very honey is poison; as has been too fatally experienced by those who have fed of the produce of the hives of Trebizonde.

Extremely different from these is the tribe of *Bindweeds* (Plate XII. 2.), of which the wild *Convolvulus*, at once the pride and pest of our English hedges, and the not less beautiful but more harmless *Ipomœa* of the gardens are the representatives. These plants, like the Heath tribe, are monopetalous, but they have a twining stem, and corollas that are neatly plaited

when they close, like the paper purses that are made for children. These corollas open and close under the influence of light or darkness, some opening only in the day, others only in the night, and in one case (Ipomœa sensitiva) they are so sensitive, that they contract beneath the touch like the leaves of the Mimosa. The calyx of the Bindweed consists of five sepals, which overlie each other so sompletely, that you can seldom perceive more than the two outermost. The fruit (*fig.* 5.) contains three or four cells, and a very small number of seeds, the embryo of which (*fig.* 7.) is doubled up in the most curious way, just as if there were not room enough within the seed for it to grow. The roots of many of them are large and fleshy; they possess powerful medicinal properties, and are fit for food only in the case of the *Sweet Potatoe* (Convolvulus Batatas), which was so much esteemed before the common Potatoe displaced it in Europe.

To this tribe also belongs an odd little plant called *Dodder* (Cuscuta). Have you never remarked upon the stems of the Heath, or Nettles, or of the Furze, clusters of stout reddish cords which are so twisted and intertwined that you would take them for a knot of young snakes, if the colour first, and then their touch did not undeceive you. If ever you have observed so strange an appearance you have seen Dodder, which, originally earth-born, soon lays hold of some neighbouring plant, twists her leafless shoots around it, fixes them firmly to the branches, quits her hold of the soil, and thenceforward, as if ashamed of

her humble origin, feeds only upon dews and rain, till the frost comes, nips her tender frame, and leaves her dead and shrivelled form still clinging to its place: a monument of the punishment of vegetable ambition. This strange plant is of the Bindweed tribe; but is extremely imperfect; leaves it has none, except a few stunted scales, and its flowers are little white things collected in close clusters. The fruit consists of membranous capsules, in each of which are two cells and four seeds.

I must now leave you to hunt for Dodder, and to study her singular habits if you can find her, till I have leisure to resume my pen.

EXPLANATION OF PLATE XII.

I. THE HEATH TRIBE.—1. A shoot of *Hispid Heath* (Erica hispida).—2. A flower; *a*, the sepals.—3. The stamens and pistil.—4. and 5 anthers.—6. A pistil cut open, shewing the arrangement of the ovules within the ovary.—7. The ripe fruit of *Rhododendron*, natural size; *a*, a central receptacle of seeds, from which the valves separate.—8. A seed very highly magnified; *a*, the hilum, or scar where the seed separated from the receptacle.—9. The same cut through perpendicularly, shewing the embryo lying in the midst of albumen.

II. THE BINDWEED TRIBE.—1. A shoot of *Dwarf Convolvulus* (Convolvulus tricolor).—2. The stigma.—3. A stamen.—4. The ovary divided perpendicularly, shewing the manner in which the ovules grow.—5. The ripe fruit.—6. A seed.—7. The same cut through perpendicularly; *a*, the radicle of the embryo; *b*, the hilum, or scar where the seed separated from the receptacle.

LETTER XIII.

THE GENTIAN TRIBE—THE OLIVE TRIBE—THE JASMINE TRIBE.

(Plate XIII.)

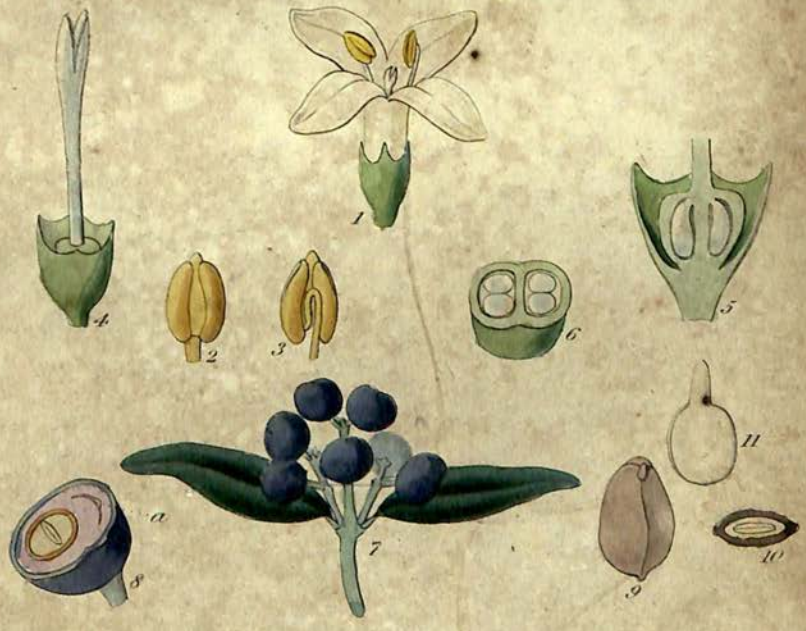
If there is any one tribe of plants in nature, the colours of whose flowers are more intensely vivid, and the foliage neater, and the whole aspect prettier than any other, it is that which comprehends the different species of Centaury, and the beautiful Alpine Gentians with their flowers of azure or yellow, This which is called the *Gentian tribe*, belongs to the Monopetalous division of Dicotyledonous plants, among which it is usually known by the leaves, which are opposite each other on the stem, being *ribbed* (that is, having two, or four, or more strong veins parallel with the midrib), and extremely bitter. The flowers are also constructed upon a peculiar plan. The calyx consists of four or five sepals more or less united, the corolla has the plaited appearance that I mentioned in the Bindweeds, with all its divisions equal to each other; there are four or five stamens, and a superior ovary, with two many-seeded cells, and a two-lobed stigma.

All this you will find in the *Gentianella* (Gentiana

The Gentian Tribe. XIII. 1.

Stemless Gentian or Gentianella.

The Olive Tribe. XIII. 2.



Privet.

acaulis, Plate XIII. 1.), a plant that you cannot fail to procure from the first good garden you enter. It indicates the presence of the bitter stomachic qualities for which the Gentian of the shops is so much employed, and you may be quite sure that they exist in any wild species in which a similar structure is discoverable. Thus we have in our marshes what is called the *Calathian Violet* (Gentiana Pneumonanthe), with narrow leaves, and a corolla greenish externally, but a lovely azure within; and on our hills, or sea-cliffs, a branchy dwarf plant with rose-coloured blossoms (Erythræa Centaurium), called *Centaury;* in both these the same bitterness occurs, and they both may be used just as well for domestic bitters as the exotic drug of the shops.

The Gentian tribe is not a very extensive one; the principal part of it is met with in the tropical countries of South America; a few species, called *Chironias*, from the Cape of Good Hope, exist in green-houses; another group, of almost uncultivable habits but great beauty, called *Sabbatias*, is found in North America; and the remainder, which are chiefly Gentians, are found all over the milder and more alpine parts of Europe and Asia; in the Swiss Alps, on Caucasus, and on the Himalayan mountains of India, they enamel the sward with blossoms of such intense brilliancy, that the eye can scarcely rest upon them.

From some unexplained cause the plants of this tribe are generally so difficult to manage in England, that with the exception of three or four robust species,

the most skilful gardeners cannot keep them alive: were it otherwise, there are none which it would be so easy and so desirable to procure from foreign countries.

Brief as my remarks upon this tribe have been, you will find that they are sufficient to enable you to recognize it. Let me now turn to another.

It is a very unusual circumstance for monopetalous plants to have only two stamens, unless the corolla is irregular: that is to say, unless the parts of the corolla are of unequal size. There are, however, two natural orders of which the essential character consists in the presence of two stamens within a regular corolla. Of these the *Olive tribe* is the more remarkable, and that which I shall take for illustration. The Olive itself is so uncommon in England, that it will be more convenient to select the *Privet* for the plant by which your notions of the tribe are to be formed.

The *Privet* is a Dicotyledonous shrub, with opposite leaves. Its calyx is a four-toothed cup: being composed of four sepals united, except just at the tips (Plate XIII. 2. *fig.* 4.). The corolla consists of four equal petals, united half-way into a tube (*fig.* 1.), and joining, before they expand, by their edges only. The stamens are two, of a very common appearance. The ovary is superior, and contains two cavities, from the top of each of which hang two ovules (*fig.* 5. & 6.); it is terminated by rather a thick style, and a two-lobed stigma. To this succeeds a small round black succulent fruit (*fig.* 7. & 8.), which usually contains but one seed. This is all that you find in any others of

the Olive tribe, the organization of whose flowers is remarkably uniform.

For example, the *Olive* has a shorter corolla and a hard bony nut in its fruit; the *Phillyrea*, with its beautiful deep-green leaves, is exactly like the Olive in the structure of its fructification, but its nut is brittle instead of bony; and the fragrant *Lilac* (Syringa) differs from all these in its longer corollas, and in its fruit being dry, and splitting into two valves.

Simple as is the character of the Olive tribe, and uniform as the genera usually are in their structure, there is one most remarkable exception, which I should not omit to notice. The *Ash* (Fraxinus), which you know by its smooth and graceful trunk, and by the airy appearance of its light and elegant foliage, is a plant without any corolla, and yet it belongs to the Olive tribe. It may seem exceedingly strange that a plant which has no corolla should be classed with those which have a perfect monopetalous one, and if such a thing were to happen in an artificial system it would be extremely improper, but in a natural arrangement all *single* characters are subordinate *to the mass of characters*, and, when they do not accord with the usual structure, form exceptions to general rules. Thus, as the Ash agrees with the Olive tribe in every character except the absence of the corolla; that absence is only reckoned an exception to the general fact that the Olive tribe has a monopetalous corolla. It happens that we possess a striking proof, beyond what the fructification affords, that the Ash and Olive

are both very nearly related to each other. It is well known that no tree can be either budded or grafted upon another, unless they are extremely nearly related by natural ties; the Olive may be grafted upon the Ash, and consequently the inference that is drawn from the construction of the flowers is confirmed by the physical properties of the two plants.

I told you but a short time since that there were two monopetalous natural orders with regular flowers, in which there are only two stamens. The one to which as yet no allusion has been made, is the *Jasmine tribe*, to which belong the many fragrant plants which bear that name. These are known by a most simple character from the Olive tribe; the edges of the divisions of their corolla, instead of being exactly fitted to each other before the flowers expand, overlie each other in the bud, and slide off each other when they unfold. These differences give rise to two technical expressions which I cannot do better than explain to you on the present occasion.

We call the manner in which the parts of the flower are folded up in the bud the *æstivation*; and we apply the term either to the calyx or corolla, or stamens, or pistils, with some qualifying adjective. When two parts are placed together, edge to edge, so that one does not lie at all upon the other, those parts are said to be *valvate*, and when they do lie upon each other, they are said to be *imbricated*, or tiled, in allusion to the manner in which tiles (called in Latin *imbrices*) are placed upon the roof of a house. These

terms are frequently coupled in speaking of the corolla: of which the Olive and Jasmine tribes afford a striking example. The former is said to have a *valvate æstivation*, the latter an *imbricated æstivation*.

EXPLANATION OF PLATE XIII.

I. The Gentian Tribe.—A plant of *Gentianella* (Gentiana acaulis).—1. The lower part of a corolla, with the five stamens attached to it.—2. A pistil.—3. An anther.—4. A ripe fruit dividing into two valves *a*, and invested with the withered remains of the calyx and corolla.

II. The Olive Tribe.—1. A flower of the *Privet* (Ligustrum vulgare).—2. The face of an anther.—3. The back of one.—4. A calyx with its pistil.—5. The same cut through perpendicularly, shewing the ovules hanging in the cells of the ovary.—6. A horizontal section of the same.—7. A cluster of ripe berries.—8. A fruit cut through, with a view of the single seed and the embryo within it; *a* the second cell, which is nearly obliterated by the pressure of the seed upon it.—9. A seed extracted from the pulp.—10. The same cut across.—11. The embryo taken out.

LETTER XIV.

THE HARE-BELL TRIBE—THE LOBELIA TRIBE—THE HONEYSUCKLE TRIBE—THE COFFEE TRIBE.

(Plate XIV.)

From the Olives of Italy, with their dingy foliage, and imperishable wood, let us turn to our own innocent native *Hare-bells*, whose modest beauty amply recompenses us for the absence of the gaudy, scented, and often venomous flowers of more southern climates. In this plant we find the representative of an extensive natural order, the species of which are scattered over all Europe and the cooler parts of Asia and America, dwelling in dells and dingles, by the banks of rivers, in shady groves, on the sides of mountains, and even on the summit of the lower Alps, where the last lingering traces of vegetation struggle with an atmosphere that neither plant nor animal can well endure.

We know the *Hare-bell tribe* only in its humblest state, bedecked with no other ornament than a few blue or purple nodding flowers; but in foreign countries, it acquires a far more striking appearance. On the mountains of Switzerland, there are species with corollas of pale yellow, spotted with black; on

The Hare-bell Tribe. XIV. 1.

Ukraine Hare-bell.

The Honeysuckle Tribe. XIV. 2.

Minorca Honeysuckle.

the Alps of India are others of the deepest purple that can be conceived: on the rocks of Madeira lives one which was formerly not uncommon in our gardens (Musschia aurea), whose corollas are of a rich golden yellow; and finally, in the pastures of the Cape of Good Hope are Roellas, the flowers of which are elegantly banded with streaks of violet or rose passing into white.

Let us, however, confine ourselves, in the first instance, to the true *Hare-bell* genus. In every shady lane there grows a diminutive herb, with little grassy leaves, and a few blue bell-shaped nodding flowers; this is the real *Hare-bell*, which Botanists call the *round-leaved Campanula;* you will wonder why it is so called, since its leaves are narrow, like those of a grass; but if you pull it up by its roots, you will then find that the lowest of all the leaves have a roundish outline, from which circumstance it derives its name. You who live in the country will take this species for examination; but I am obliged to step into a garden for a subject, and I have selected a species found in thickets in the Ukraine, from which it is named Campanula ucranica; either will answer the purpose equally well.

The calyx of the plant has five deep divisions (Plate XIV. 1.), which spread regularly away from the base of the corolla, and from the top of the ovary. The corolla has very regularly the figure of a bell, except that it is too narrow at the base; its borders is divided into five lobes, which shew that it is made up of five petals, and it is veined in a pretty and

peculiar manner. From the base of the corolla, and consequently from the summit of the ovary, spring five stamens (*fig.* 1.), whose filaments are broad, firm, and fringed (*fig.* 2.), curving inwards at the base, and bending over the top of the ovary, as if to guard it from injury; their points touch the style, and keep the anthers parallel, and in contact with it, till they shrivel up and fall back, which happens immediately after the flower unfolds. The style is a taper stiff column, about the length of the corolla, and longer than the stamens. It is covered all over, up to the very tips of the stigma, with stiff hairs (*fig.* 4.) which nature has provided to sweep the pollen out of the cells of the anthers, as the style passes through them in lengthening; if it were not for this simple but effectual contrivance, as the anthers burst as soon as ever the corolla opens, their pollen would drop out of the nodding flowers and be lost before the stigma was expanded and ready to receive the fertilizing influence; the hairs of the style catch the pollen and keep it till insects, wind, or accident brush it down upon the inverted stigmas.

Next let us look at the ovary. This organ is in the *Hare-bell* a case containing three cavities or cells (*fig.* 3.), surrounding a central axis; in each cell there is a large fleshy receptacle, over which is spread a multitude of ovules. After the stigma is fertilized, the corolla and the stamens drop off, the sepals harden, enlarge, and collapse, all the parts become browner and thicker, stout ribs appear in the substance of the ovary, which droops still more than

the flower itself (*fig.* 5.), and at last a general dryness, hardness, and brownness, announce that the ripening of the fruit is accomplished. But how are the dust-like seeds ever to find their way out of this lidless box, or to penetrate its tough sides? Considering what happens in so many other plants, we should naturally expect that it would take place by a separation of the edges of the three carpels into valves, near their points; but upon looking at the top of the ovary between the sepals, we find that part still tougher than the sides, and without the slightest appearance of an opening. It is by a rending of the thinnest part of the sides of the fruit, in the fork of the three principal ribs (*fig.* 5. *a.*), that these valves are produced, and that nature provides for the escape of the seeds; the rending takes place upon the final drying of the sides of the fruit, when every part becomes stretched so tight, that any weak portion must of necessity give way. As the stretching takes place with uniformity, and as the skin at the forks of the ribs is always more tender than any other part, the opening of the valves will consequently occur with the same invariable certainty as the formation of the seeds.

Do not, however, suppose that this curious contrivance is characteristic of the Hare-bell *tribe:* on the contrary, it is only characteristic of the Hare-bell *genus;* for in other genera, the fruit opens by a separation of the points of the carpels in the usual way; the tension of the sides consequently does not take place, and no lateral openings being necessary, none are ever formed.

Among the commoner genera, allied to the Hare-bell, should be distinguished *Phyteuma*, some very pretty species of which are found on the Alps of Europe, and two, even in hedges in the south of England, although very rarely; this genus is known from the Hare-bell by its corolla not being bell-shaped, but split into five very long and narrow segments. *Wahlenbergia* also, with the corolla of a Hare-bell, but with the fruit opening at the points, is found in the damp groves of Cornwall and Devonshire, in the shape of a charming little ivy-leaved plant, creeping among the turf, above which it raises its blueish drooping bells (Wahlenbergia hederacea); and finally in corn-fields, often enamelling the stubble in harvest time, appears the *hybrid Looking-glass flower* (Specularia hybrida), the corolla of which spreads flat round the stamens, forming little rays with its petals; its fruit sheds its seeds through three slits in its angles.

The Hare-bell tribe is as harmless as it is beautiful; the roots of some species are eaten under the name of Rampion, the leaves of others are used in Salads, and the bells afford an abundant supply of honey to the bee. The stems and roots abound in a milky juice, which although in this case innoxious, is usually a symptom of poisonous properties, and which, in a neighbouring tribe, indicates the presence of the most fearful venom. As the gardens contain many species of the deleterious group, called the *Lobelia tribe*, I cannot do better than take this opportunity of explaining to you how you may know them.

Imagine a Hare-bell with its corolla split into an

irregular form, and its anthers grown together into a cylinder through which the stigma projects, and you will have a *Lobelia*, many of the species of which, such as *L. Cardinalis, fulgens* and *splendens*, are the admiration of gardeners, on account of their velvety scarlet flowers. Put not your faith in these, for they are all acrid in the most intense degree, and fatal alike to animals and man. They are very common in tropical countries, and are chiefly American; some of them are herbs like those we see in the gardens, others are bushes, or even small trees. Two of the rarest of British plants are the *burning Lobelia* (L. urens) of Devonshire, and the *water Lobelia* (L. Dortmanna), which inhabits the very bottom of mountainous or northern lakes.

Resembling the Hare-bell tribe in its inferior ovary, but far different in its essential characters, is the tribe which takes its name from the *Honeysuckle*. To understand the structure of this, you cannot do better than study the Honeysuckle itself (Plate XIV. 2.). The leaves of that plant are placed opposite each other with great uniformity; the uppermost even grow together at their base; in no case do you find even a trace of stipules, or any thing like them; a material point, which I must beg you to remark.

The flowers have a roundish green inferior ovary (*fig.* 1. *a.*), terminated by a very minute five-toothed calyx, and containing three cells (*fig.* 3.), in each of which hang two or three ovules. The corolla is a tube, the end of which divides into two lips (*fig.* 1.), one of which is narrow and undivided, the other cut

into four rounded lobes: in reality, it is composed of five petals, one of which is separate for about a quarter of its length, and constitutes the undivided lip, while the other four are united nearly to their very points, and form the upper lip. Five stamens arise from the tube of the corolla; the style is long and thread-shaped, and ends in a pin-headed stigma. The fruit is a succulent berry, containing one or two bony seeds (*fig.* 6.).

Such is the Honeysuckle, the essence of whose character, consisting in having an inferior, many-celled, few-seeded ovary, and monopetalous flowers, is found in Symphoria, one of whose species bears balls of snow-white fruit, whence it has gained the name of *Snow-berry;* and in the *St. Peter's Wort* (Diervilla), the fruit of which is dry and tapering. It is here also that is stationed the interesting *Linnæa borealis*, with its delicate rosy bells, and creeping stems; by which it is said that the humble and neglected fate and early maturity of the great Swedish naturalist, whose name it bears, were typified, at the time it received its modern title.

Do not imagine that because the Honeysuckle twines, and Linnæa trails, all the tribes are twiners, or trailers. On the contrary, if you are acquainted with either the Snow-berry or the St. Peter's Wort, already mentioned, or with the *Tartarian and Fly Honeysuckles* of the gardens, you will already be aware that many species are upright branching bushes. This is more particularly the case with some other genera. The *Elder*, of which I long

since gave you a description (page 35), warning you not to mistake it for an Umbelliferous plant, belongs to the Honeysuckle tribe; and so do the *Wayfaring tree* (Viburnum Lantana), and the *Guelder Rose* (Viburnum Opulus), both of which are to be met with in every shrubbery. At first sight, these plants seem to be unlike the Honeysuckle, but study their structure carefully, remembering what it is that I have told you is essential to the tribe, and you cannot mistake their affinity. In fact, if they were twining you would never have doubted it.

In North America there grows a plant of this tribe with broad leaves, clusters of flowers sitting close in their bosom, and yellow berries, called Triosteum perfoliatum, the seeds of which have proved the best of all substitutes for Coffee. Knowing nothing of the latter plant, you cannot have suspected that it was in any way allied to the Honeysuckles; but the fact I have now mentioned may excite a suspicion that it may be so, as in reality it is.

Coffee (Coffea Arabica), the infusion of whose seeds forms the beverage which is probably the most universally grateful of all that the luxury of man has prepared, belongs to a very extensive natural order, almost confined to the warmer parts of the world, comprehending the meanest weeds and the most noble flowering trees, obscure herbs with blossoms that it almost requires a microscope to detect, and bushes whose scarlet corollas are many inches long; and producing drugs invaluable to man for their important medicinal properties. Ipecacuanha,

Coffee, and various kinds of fever barks, especially that of Peru, are among its useful products. Now, if you gave the Honeysuckle tribe well defined stipules at the base of the leaves, you would convert them into plants of the *Coffee tribe*; for, notwithstanding many other differences in particular instances, the two natural orders, viewed in a general manner, can hardly be said to be absolutely distinguishable by any other character. I would, therefore, recommend you to take this as the true distinction, and not to trouble yourself about further differences, unless you intend to study Botany minutely. Coffee itself consists of the seeds of the plant, divested of their skins, and of a dark purple fleshy rind that enveloped them. They are formed almost entirely of albumen, in the base of which a very small embryo is placed. A seed of any commom Honeysuckle (*figs.* 6. & 7. Plate XIV. 2.) will shew you this; for, in all that regards the seed, the Coffee tribe and the Honeysuckles agree. I have said that Triosteum has proved the best of all substitutes for Coffee; a circumstance that will not now surprise you; but it is probable that other plants of either the Honeysuckle or Coffee tribes, would answer the purpose equally well, provided their seeds are large enough, and their albumen of a hard horny texture.

EXPLANATION OF PLATE XIV.

I. The Hare-bell Tribe.—A few flowers of the *Ukraine Hare-bell* (Campanula ucranica).—1. The ovary *a*, with the stamens and style, in the state in which they are found after the corolla has expanded.—2. A stamen with its broad thick base.—3. A horizontal section of the ovary, shewing the three cells and many seeds.—4. A view of the hairy style and stigma, before the lobes of the latter separate.—5. A ripe fruit; *a*, the holes through which the seeds escape. —6. A seed.—7. The same cut perpendicularly, shewing the embryo.

II. The Honeysuckle Tribe.—A piece of the *Minorca Honeysuckle* (Caprifolium implexum).—1. A flower, with the inferior ovary. —2. An anther, with the upper end of the filament.—3. A horizontal section of an ovary, with the three cells, and the ovules cut through as they hung in them.—4. A perpendicular section of an ovary, shewing how the ovules hang from the top of the cavity.—5. A little cluster of fruit.—6. A seed.—7. The same cut through perpendicularly, shewing the embryo.

LETTER XV.

THE BORAGE TRIBE—THE NIGHTSHADE TRIBE—THE PRIMROSE TRIBE.

(Plate XV.)

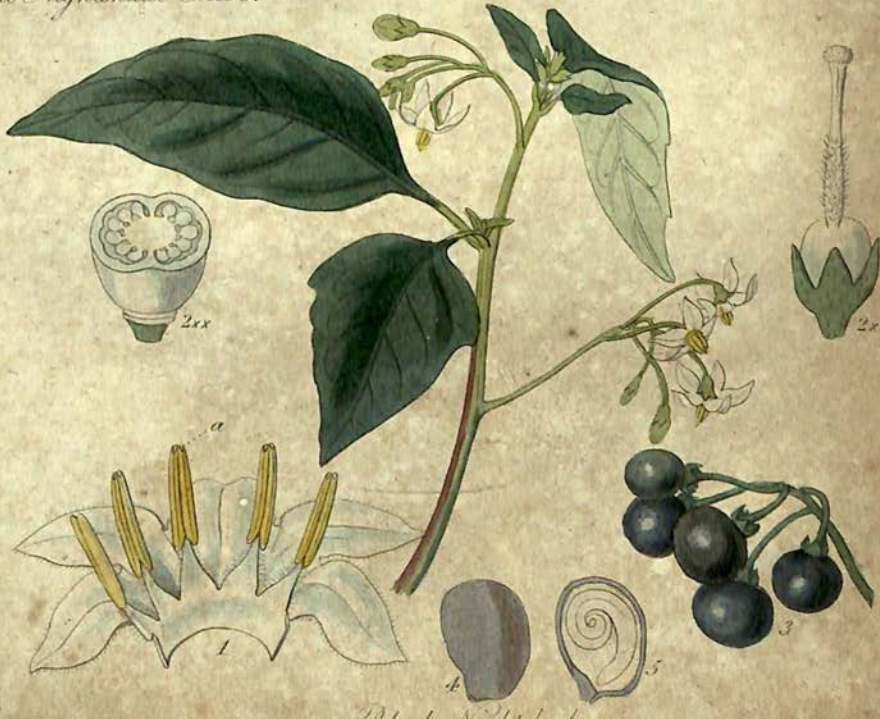
I HOPE that you will have found the distinguishing characters of all the Monopetalous orders we have examined up to this time sufficiently clear and definite to be understood and remembered; and that as I have been proceeding, you have been analysing their distinctions after the plan of which some instances have been already given you. For I am convinced by long experience that this is the only sure way of fixing such matters in the memory. As it is my intention, after we shall have gone through the whole of them, to analyse for you such of the Monopetalous orders as I may select for illustration, it is unnecessary for me to dwell as yet upon their mutual distinctions. Let us, on the contrary, proceed, for the present, steadily in our examination of other natural orders.

Of all the groups into which Botanists have divided the Vegetable Kingdom, there is none which combines uniformity of general appearance with similarity in structure in a greater degree than those rough-leaved plants, which Linnæus used, on

The Borage Tribe. N°. 1.

Violet Alkanet.

The Nightshade Tribe. XI. 2.



Black Nightshade.

that account, to call Asperifoliæ, and which we know by the name of the *Borage tribe.* Leaves covered with rigid hairs, a regular monopetalous corolla, and a four-lobed ovary, which changes into four seed-like grains, form the peculiar character of this natural order, of which the *Violet Alkanet* (Anchusa italica) is a common and good illustration. In Botanic gardens, or in collections of biennial plants, this is an extremely common plant, so that I anticipate no difficulty in your procuring it. Should you, however, be unable to procure it when this letter reaches you, take a shoot of *Forget-me-not*, by which you may also follow me. My reason for selecting the Alkanet, is the large size of all its parts of fructification.

The leaves of this plant have a fleshy texture and a mucilaginous pulp; but their skin is covered with hairs so stiff and sharp that they will prick the fingers if drawn over them against the hairs. A miscroscope will shew you that this is owing not so much to the stiffness of the hairs themselves, as to a hard stony base from which they arise, and which if your magnifying power is strong enough, will be found to consist of a cluster of very hard cells of cellular tissue. When the leaves are young, this hardness is less remarkable; but as they grow old, it becomes very conspicuous. The leaves are placed alternately on the stem, and the latter is round—two facts which I will beg you to recollect.

The flowers are arranged in a singular manner. The stalk which bears them is coiled up (Plate XV. 1.)

at the point, so that the youngest flowers are quite hidden by its folds; but it gradually uncoils as the flowers expand, till at last it becomes nearly straight. In consequence of this singular arrangement, the flowers are all forced towards one side, and when they are expanded, look as if they actually grew from one side only; this, however, is not the fact—they are only turned towards one side. I think I have already explained to you that we call the arrangement of the flowers upon their common stalk the *inflorescence;* and that different adjectives are added to this word to explain its nature. Thus, in Umbelliferous plants, the inflorescence was umbelled; in the Borage tribe it is what is called *gyrate;* a fine word expressive of being coiled. Now this gyrate inflorescence will of itself enable you to recognise the Borage tribe, and the families most immediately allied to it, without recourse to any thing further.

The calyx, which is covered with hairs, like the leaves, consist of five sepals joined to each other more than half way, so as to form a tube (*fig.* 2.). The corolla has its border divided into five lobes, opposite which, at their base, are five hairy convex scales, which converge and close over the mouth of the tube, so as effectually to prevent any intruder from entering it (*fig.* 1.). From the side of the tube of the corolla, below the scales, spring five stamens, which sit close upon its surface, without any visible filament. The ovary is divided into four deep lobes (*fig.* 3.), from the middle of which rises a taper style, terminating in a double stigma.

When the fruit is ripe it is invested with the calyx, which remains green for a long time (*fig.* 4.), only contracting at the point, so as to cover the fruit. Corresponding with the four lobes of the ovary, are four grains, or rather rugged bony nuts (*fig.* 5.), which finally separate from each other, when they look like so many seeds, for which they used to be mistaken. These, along with the gyrate inflorescence, are the great characters of the Borage tribe, as distinguished from all other Monopetalous Natural Orders.

Many of the genera of the Borage tribe are extremely common. The most beautiful of all our wild flowers, *Viper's Bugloss* (Echium vulgare), is one of them. It is known by its corolla having an unequal and irregular margin, and a sort of bell-shaped figure. The deep red or purple spots and hairs of that plant are very remarkable.

Then there is *Forget-me-not* (Myosotis), whose various species ornament ditches and dry banks with their pretty blue blossoms. It is known from Alkanet only by the scales of the mouth of its corolla being more rounded and shorter.

Borage, too (Borago officinalis), occasionally makes its appearance upon banks, and in waste places; it is conspicuous for its azure flowers, whose corolla is deeply divided into five spreading lobes, which are much longer than the tube.

Besides these, we have *Hound's-tongue* (Cynoglossum), with long grey leaves, and dingy reddish brown flowers, succeeded by broad fruit, covered all over with stiff hooks; *Lungwort* (Pulmonaria), with leaves

spotted with green and white, and flowers of a lovely blue, shaped like a funnel; the mean-looking *Gromwell* (Lithospermum), which seems as if conscious of its worthlessness, by constantly dwelling with weeds and rubbish; whose very fruit is so like a stone, that it derives its Botanical name (Lithospermum signifies literally stone-seed,) from that circumstance; and finally *Comfrey* (Symphytum), with tall coarse stems, and tubular flowers, the scales of whose mouth seem as if made expressly to teach us what the real nature of those singular parts are in other genera. In the Comfrey, the scales are so exactly like the filaments, that if you cut off the anthers, you cannot tell one from the other; and consequently, as all other circumstances confirm the opinion of their being abortive stamens, the scales are so considered.

Not one of the Borage tribe is otherwise than harmless; the young shoots of Comfrey have even been eaten as Asparagus, but they have too little taste to be worth cultivation; and Borage itself was once an ingredient in a favourite beverage of our forefathers, called a cool tankard. It is however for their dyeing properties that they are really valuable. The dye called Alkanet, or others of a similar quality, is furnished by the roots of Anchusa tinctoria, Lithospermum tinctorium, Onosma echioides, and several other species.

From this harmless natural order, let us turn to one, the properties of which are too often dangerous. Henbane, Nightshade, and Tobacco, the narcotic

Thorn-apple, with the half fabulous Mandrake, whose roots were said to shriek as they were torn from the earth to give effect to magical incantations, form, with a number of other plants, a large natural order, the prevailing quality of which is to be poisonous. Many of them are common wild plants, and none more so than the species called *Black Nightshade* (Solanum nigrum), which is sure to spring up wherever a spot of ground is neglected, and suffered to become waste. It is to this plant I shall trust for explaining the general character of the *Nightshade tribe.*

Black Nightshade is a plant with broadly lance-shaped leaves, slightly toothed at the edge, and seated alternately upon the stem (Plate XV. 2.). Its flowers consist of a short five-toothed calyx, of a monopetalous corolla, with five equal divisions (*fig.* 1.), of five equal stamens, and of an ovary (*fig.* 2**.) with two cells, in each of which is a number of ovules. The style of the ovary is thick and shaggy at the bottom, and terminated by a thickened undivided stigma. The fruit is a small black berry, containing two cells, and a number of yellowish seeds, whose skin is covered closely with little pits (*fig.* 4.); in the inside is an embryo, which is coiled up upon itself in the middle of a quantity of fleshy albumen (*fig.* 5.). Of these characters, the most essential ones are the *superior ovary with two cells, the regular flower, and the alternate leaves.* The last point distinguishes the Nightshade tribe from the Gentians, and you will find, by and bye, that the two

former separate it from other orders you have still to examine.

The genus Solanum is known in its tribe by the anthers opening by two holes or pores at their points (*fig.* 1. *a.*); besides Black Nightshade, it contains the *Bitter-sweet* (S. Dulcamara), whose red and tempting berries present a dangerous decoy to children; the *Love Apple* (S. Lycopersicum), or *Tomato*, the pulp of which is so much esteemed in sauces; the *Egg-plant*, or *Aubergine* (S. Melongena), whose fruit, when fried in slices, forms a delicacy in French cookery; and above all, the *Potatoe* (S. tuberosum). Here, you will imagine, is a singular assortment of eatable and poisonous plants in the same genus; but in truth, the fruit of these is in all cases deleterious till it is cooked; Tomatoes are stewed, Egg-plants are washed and fried before they are eaten, and it is not to be doubted that they would all prove injurious, if used in a raw state. The fruit of the Potatoe is notoriously unwholesome; and if its roots are not so, that circumstance is to be ascribed in part to their being cooked, and in part to their being composed almost entirely of a substance like flour, which in no plant is poisonous, if it can be separated either by heat or by washing, from the watery or pulpy matter it may lie among.

Deadly Nightshade (Atropa Belladonna) belongs to a genus resembling the last in its berries, but having a bell-shaped flower, and anthers which open by slits in the usual way. The fruit of this plant is the most venomous of all our wild berries; it is of a deep

shining black, and follows a livid brown corolla. The *Mandrake* is a species of the same genus (Atropa Madragora), but it has whitish flowers veined with purple; and scarcely any stems; it is only found in the southern parts of Europe.

Henbane (Hyoscyamus niger) lives on commons, especially where the soil is chalky, near old cities and upon banks. Its broad pale leaves have a fetid smell, are irregularly lobed at the edges, and are covered all over with greasy hairs. The flower sits close upon the stem, and have a large dirty-yellow corolla, veined with brownish purple, which gives them a peculiar livid appearance.

The *Thorn-apple* (Datura Stramonium), so celebrated for its narcotic properties, is distinguished by its fruit being dry and covered with stiff spines; and *Tobacco* (Nicotiana Tabacum) by its long tubular corolla and smooth dry fruit bursting into two valves.

To enumerate any greater number of these deleterious plants would be to occupy a larger space than I have room for; what I have already mentioned will suffice to make you understand their general nature; and for the rest you must consult systematic works. All that I beg you to recollect is, that plants of the Nightshade tribe, are not only monopetalous, but have *a superior two-celled ovary, regular 5-lobed flowers, and alternate leaves.* The fruit of all such avoid, until it has been ascertained by the experience of others, that they can be eaten with safety.

You will scarcely suspect that those prettiest of spring flowers, *Primroses, Oxlips,* and *Cowslips,* can be

in any way related to the venomous plants I have just mentioned; nor do they in fact belong to the same tribe; but they are so similar in many respects that I shall have no opportunity more fitting than the present, to say a word to you about them. Endeared as they are to us all by some of the sweetest recollections of infancy, it would almost amount to a crime to pass them by with neglect. Like the Nightshade tribe they have regular monopetalous flowers with five stamens, and a superior ovary; they are sometimes similar in habit, as in the case of the Mandrake, which resembles a gigantic Primrose with white flowers marked by purple veins, and they also possess slight narcotic properties. They are distinguished by one circumstance in particular, by which they may be at all times known among our wild flowers with certainty,—*their stamens are not placed between the lobes of the corolla,* as in the Nightshade tribe, *but are opposite to them,* a very curious and permanent difference.

This you will instantly discover by the examination of the *Primrose,* the *Auricula,* or the *Polyanthus.* The ovary is also constructed on a different plan: you will find that of the Primrose to contain only one cell, with the ovules collected in the centre: in the Nightshade tribe there are two cells; on the outside of the ovary of the latter, you will discover two furrows on opposite sides of it, indicating that it is constituted by the growing together of a pair of carpels: on the outside of the ovary of the Primrose are five furrows, slight indeed, but sufficiently apparent, and

indicating its formation out of five carpels. The peculiarity in the stamens is, however, sufficient without referring to the fruit, except when the corolla has fallen off.

With this character agree the beautiful pigmy Alpine plants called *Aretia* and *Androsace;* here also are referred *Soldanella* with its little bells of blue so prettily notched on the border and Cyclamen or *Sow-bread*, whose fruit is forced, by the rigid coiling up of the flower-stalk, down upon the earth, where it lies concealed by the broad ivy-like leaves. Here too are arranged the *Pimpernel* (Anagallis), one of whose species is called the *Poor Man's Weather-glass*, because it is found in every piece of waste ground, and will only open its tiny brick-red flowers in fine weather, closing them at the approach of rain; and *Loosestrife* (Lysimachia), whose creeping stems, little yellowish-green leaves, and brilliant yellow flowers are the brightest ornaments of the moss and short herbage that springs up in woods and shady places.

Interesting as are the British species of this natural order, they are far inferior in beauty to their relations which live on the mountains of other countries: for the Primrose tribe most frequently prefers Alpine stations to all others. It is in the higher regions of the mountains of Switzerland and Germany, on the Pyrenees, and upon those stupendous ridges, from which the traveller beholds the vast plains of India stretching at his feet in a boundless panorama, that the Primrose tribe acquires its greatest beauty. Living unharmed beneath a bed of snow during the

cold weather, where it is protected alike from light and from drying winds, as soon as the snow is melted it springs forth bedecked with the gayest tints imaginable; yellow, and white, and purple, violet, lilac, and sky blue are the usual colours of its flowers; while its leaves, nursed by the food descending from a thousand rills of the purest waters, and expanded beneath an ever genial and cloudless sky, acquire a green which no gem can excel in depth or brightness. It is in those regions only that the Primrose tribe can be studied to the greatest advantage.

EXPLANATION OF PLATE XV.

I. THE BORAGE TRIBE.—A portion of the inflorescence of *Violet Alkanet* (Anchusa italica), shewing its gyrate disposition.—1. A corolla opened, exhibiting the stamens and the scales which close its throat.—2. A calyx.—3. The four-lobed ovary, style and stigma.—4. The calyx of the fruit.—5. The four-lobed fruit with the withered style still remaining.—6. One of the seed-like lobes of the fruit divided perpendicularly; *a*, the part which separated from the receptacle; *b*, the organic apex; *c*, the organic base: these are inverted in the drawing so that the section may correspond with the position of the lobes in fig. 5.

II. THE NIGHTSHADE TRIBE.—A twig of *Black Nightshade* (Solanum nigrum).—1. A corolla laid open; *a*, the holes through which the pollen is discharged by the anthers.—2*. The pistil and calyx.—2**. A horizontal section of the ovary, exhibiting the numerous seeds lying in the two cells.—3. A cluster of ripe fruit.—4. A seed.—5. The same divided perpendicularly, shewing the manner in which the embryo is coiled up.

The Mint Tribe.

XVI. 1.

Black Horehound.

The Foxglove Tribe.

XVI. 2.

Purple Foxglove.

LETTER XVI.

THE MINT TRIBE—THE FOXGLOVE TRIBE.

(Plate XVI.)

One of the easiest of all natural orders to recognise is the Borage tribe, which formed the subject of part of my last letter. Its coiled or gyrate inflorescence and four-lobed ovary are so peculiar, as never to escape the observation of the most careless inquirer. There is only one way in which a mistake may be made by a beginner, and that I shall now teach you how to avoid.

Of all the weeds of common occurrence, that which is perhaps the most universally distributed, and which appears by the strength of its constitution the best adapted to flourish in situations where little else can grow, is *Black Horehound* (Ballota nigra). Even by the sides of the high road, in the midst of the hottest and dryest weather, when it becomes literally cased in a thick coating of dust, that plant flowers, regardless of the elements and their effects. You may know it by its dull dusty disagreeable smell, its roundish indented wrinkled dull grey leaves, placed opposite each other on a square stem, and its whorled clusters of dull purple flowers. The ovary is split

into four lobes; its fruit consists of four black grains, which are the divisions of the ovary in a hardened state, and in fact it is so very like the fruit of a plant of the Borage tribe, that I am quite sure when you look at its monopetalous corolla, you will believe that it belongs to that natural order.

But pursue your examination of it a little further, and see whether its other characters are also in accordance with those of the Borage tribe. Its leaves for example—are they covered with stiff hairs? no—are they placed alternately on the stem? no—have they the insipid taste, &c. of the Borages? no—are the flowers arranged in a coiled or gyrate inflorescence? is the corolla regular? are there five stamens? to all these questions the answer still is no, no, no. The Black Horehound does not belong to the Borage tribe.

Look then rather more exactly into the structure of the flowers; for there can now be no doubt that it is a part of some natural order you have not yet examined. Its calyx (Plate XVI. 1. *fig.* 1.) is a tube with five sharp-pointed teeth (*a.*), and is consequently formed of five sepals. The corolla is hairy and tubular at the base (*fig.* 1.), and divided at the top into two unequal parts called *lips;* of these lips the upper is narrow and concave (*b.*), the lower is flat, and divided into three lobes (*c.*), of which that in the middle is much larger than the two side ones; this corolla is therefore *very irregular.* To see the stamens distinctly, the best plan is to slit open the corolla (*fig.* 2.); you will then find that there are four of them,

two being shorter than the others; their anthers consist of two lobes which diverge very much, and are only connected just at the tips (*fig.* 3.). The structure of the ovary and fruit (*figs.* 4. & 6.) is like that of the Borage tribe; but the style is uniformly forked at its upper end, and has a very minute stigma on each point of the fork (*fig.* 5.).

Plants thus constructed, and there is a considerable number of them, form what Botanists term *Labiatæ*, and which may be called in English *the Mint tribe*. They are known from all, except the Borages, by their four-lobed ovary; and from the Borages they are distinguished by their opposite leaves, square stems, irregular flowers, and several other characters; especially by a total difference in their sensible properties. While all the Borages are insipid and scentless, the Mint tribe consists of aromatic herbs, whose leaves and flowers are both impregnated with a volatile matter which is continually exhaling, and which becomes exceedingly perceptible when the parts are rubbed. For instance, *Lavender*, *Thyme*, and *Rosemary*, *Mint*, *Basil*, *Sage*, *Marjoram*, and *Clary*, the common aromatic herbs of the Kitchen Garden, are all relatives of each other, and belong to this natural order.

Of our wild flowers the most remarkable genera, besides those above mentioned, are the *Dead Nettles* (Lamium), with their strong-smelling leaves and flowers of purple or white; *Bugles* (Ajuga), with blue flowers and creeping stems; *Ground Ivy* (Glechoma), that crawls over the bottoms of dry ditches and up

the sides of banks among the grass; *Woundwort* (Stachys), which owes its name to the blood-red stains upon its corolla; *Self-heal* (Prunella), peeping up among the sward of commons and old pastures; and *Gipsy-wort* (Lycopus), with its minute pale rosy flowers, which inhabits the banks of rivers and lakes, and yields a deep brown stain when its leaves are bruised in water.

All these and a thousand more agree in having perfectly harmless properties, and are for the most part aromatic; their favourite places of resort are hedges, woods, and shady lanes; they spring up on the sloping face of chalky downs, and enamel the meadows of subalpine regions; even the scorching sun of Syrian deserts they can endure, but they are unable to support the most intense cold in which vegetation can exist. In Melville Island, for instance, situated in the Arctic Ocean, none of the tribe were found by Captain Parry's officers, although Saxifrages, little Potentillas, and many other pretty flowers appear in the summer through the thin coating of soil which conceals the everlasting ice of that desolate region.

Far removed from these in their qualities, for many are poisonous, and all suspicious, although extremely similar in most points of organization, are the beautiful plants which form the *Foxglove tribe* (Plate XVI. 2.). They are known by their fruit not consisting of four seed-like lobes, but being a hollow case, or capsule (*fig.* 7.), containing two cells (*fig.* 9.), and a great number of seeds. In the irregu-

larity of the corolla and stamens, they exactly agree with the last, only it is carried much farther in the Foxglove tribe than in the Mint tribe: for the petals are sometimes so irregularly combined, that one can scarcely make out their real number and nature by any of the ordinary tests; as in the charming genus *Calceolaria*, the lower lip of whose corolla is inflated like the foot of a clumsy slipper, and in the still more remarkable Chilian *Schizanthus*, whose corolla is cut and slashed as if it had been clipped with a pair of shears.

No better example of this order can be selected than the common *Foxglove* (Digitalis), which is so striking an ornament of many parts of England. Its corolla (*fig.* 1.) is a large inflated body, with its throat spotted with rich purple, and it border divided obliquely into five very short lobes, of which the two upper are the smaller; its four stamens are of unequal length (*fig.* 2.); and its style is divided into two lobes (*fig.* 6.) at the upper end. A number of long glandular hairs cover the ovary (*fig.* 5.), which contains two cells, and a great quantity of ovules.

This will show you what the usual character is of the Foxglove tribe; and you will find that all the other genera referred to it in books agree with it essentially, although they differ in subordinate points. It is chiefly in the form of the corolla, in the number of the stamens, in the consistence of the rind of the fruit, its form, and the number of seeds it contains, and in the manner in which the sepals are combined, that these differences consist.

Thus *Figwort* (Scrophularia) has a globular corolla, with a large upper, and a very small lower lip; *Speedwell* (Veronica), with its spikes of blue, has only two stamens; *Snapdragon* (Antirrhinum) has the throat of the lower lip so prominent as to press against the upper; *Monkey flowers* (Mimulus) have the angles of the calyx winged; and the woolly *Mulleins* (Verbascum), a corolla with scarcely any tube. No genus is more remarkable than Pentstemon, of which so many fine American species adorn our gardens; in that plant there are actually five stamens, four of which are of two different lengths, as is usual, while the fifth is long and slender, very hairy at the point, and projects into the very mouth of the corolla; it is, however, notwithstanding its size, imperfect: for it bears no anther. This plant is interesting, as shewing that in such irregular flowers as those of the Mint and Foxglove tribes, there is a tendency to become regular, which is sometimes very strongly manifested. To render a Foxglove regular, it should not only have the divisions of its calyx and corolla of the same size, and of the same number; but the stamens should agree in number with those; that is to say, as there are five sepals and five lobes to the corolla, there should also be five stamens, instead of four, to constitute perfect regularity. It is considered that in those plants in which there are only four stamens, the fifth is abortive or undeveloped, and that when two stamens only appear, the three others are abortive. This will explain to you why a fifth stamen appears in Pentstemon; and also the

nature of a little scale which is very often found at the back of the corolla in these two-lipped corollas; the scale is a stamen in a rudimentary state.

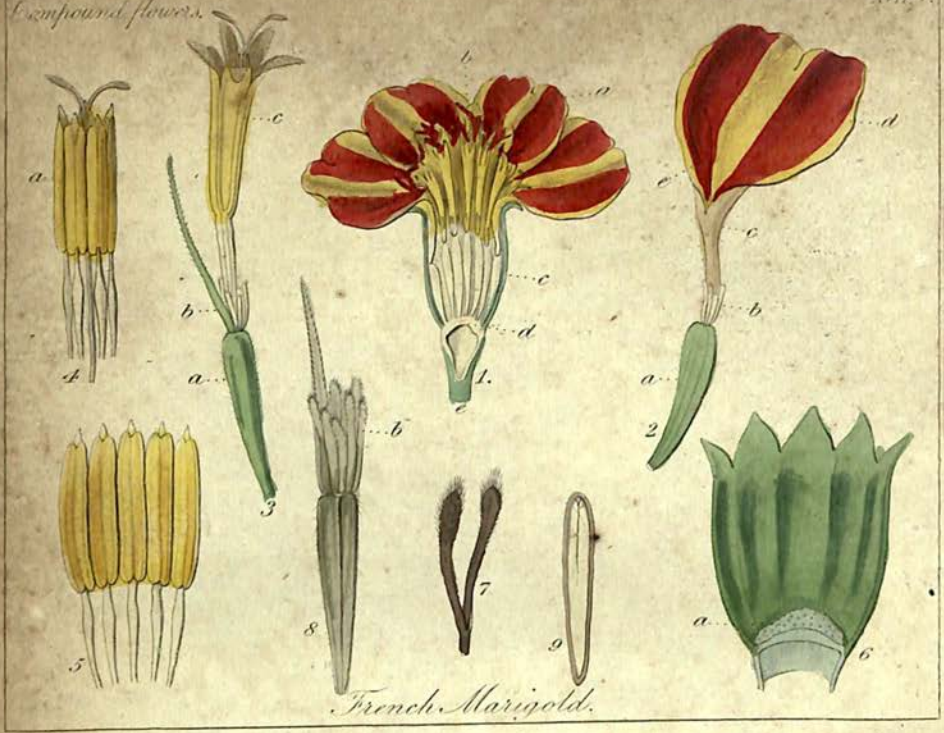
If you next compare the structure of the Foxglove tribe with that of the Nightshade, you will remark that the resemblance between them is quite as great as between the Foxglove and the Mint tribe; only in a different way. They both have monopetalous flowers, five divisions of the calyx and corolla, and an ovary with two cells; but in the Nightshade tribe the stamens uniformly correspond in number with the lobes of the calyx and corolla; while in the Foxglove tribe they are uniformly fewer; in a word, the flowers of the former are symmetrical and regular, of the latter, unsymmetrical and irregular, and this is the great distinction between them.

With this I must abandon the explanation of the Monopetalous Dicotyledonous natural orders, which have more than one carpel in each flower; my next letter will be confined to those, the carpel of which is absolutely solitary and simple.

EXPLANATION OF PLATE XVI.

I. THE MINT TRIBE.—1. A flower of *Black Horehound* (Ballota nigra); *a*, a lobe of the calyx; *b*, the upper lip of the corolla; *c*, the lower lip.—2. A corolla split open to shew the position of the stamens.—3. The top of a filament, with its anther.—4. A pistil; *a*, a fleshy disk, out of which springs the four-lobed ovary.—5. The two lobes of the style.—6. A ripe fruit before the lobes separate.—7. One of the lobes apart.—8. A fruit cut through horizontally, shewing the four embryos at *a*.

II. The Foxglove Tribe.—1. A flower of *Purple Foxglove* (Digitalis purpurea).—2. The stamens projecting from the base of the corolla.—3. An anther.—4. The pistil, after the corolla has dropped off.—5. The same without its calyx.—6. The top of the style and the stigma.—7. A ripe fruit, burst into two valves, and leaving the receptacles of the seeds in the middle.—8. A perpendicular section of the same, with the receptacles left.—9. A horizontal section of a half-grown fruit, shewing the precise shape of the receptacles of the seeds.—10. A seed.—11. A perpendicular, and 12, a horizontal section of the same, exhibiting the embryo lying in the midst of albumen. (N. B. These details are after a drawing by Mr. Francis Bauer).



French Marigold.

The Rib grass Tribe. XVII.2.

Broad leaved Rib grass.

LETTER XVII.

COMPOSITE FLOWERS—THE RIBGRASS TRIBE.

(Plate XVII.)

BEFORE I come to my promised analysis of the orders of Monopetalous plants I must beg you to give your attention to two more tribes, in which there are many singular points of structure, and which in particular differs from all that have gone before in having only one carpel in each flower; a simple and obvious difference, which you will be sure to remember.

"Take," says Rousseau, whom I shall here follow very closely, "Take one of those little flowers which cover all the pastures, and which every body knows by the name of *Daisy*. Look at it well; for I am sure you would have never guessed from its appearance, that this flower, which is so small and delicate, is really composed of between two and three hundred other flowers, all of them perfect, that is, each of them having its corolla, stamens, pistil, and fruit; in a word, as perfect in its species as a flower of the Hyacinth or Lily. Every one of those leaves, which are white above and red underneath, and form a kind of crown round the flower, appearing to

be nothing more than little petals, are in reality so many true flowers; and every one of those tiny yellow things also, which you see in the centre, and which at first you have perhaps taken for nothing but stamens, are real flowers. If your fingers were already exercised in botanical dissections, and you were armed with a good glass, and plenty of patience, I might convince you of the truth of this; but at present you must begin, if you please, by believing me on my word, for fear of fatiguing your attention upon atoms. However, to put you at least in the way, pull out one of the white leaves from the flower; you will think at first that it is flat from one end to the other; but look carefully at the end by which it was fastened to the flower, and you will see that this end is not flat, but round and hollow, in form of a tube, and that a little thread ending in two horns, issues from the tube; this thread is the forked style of the flower, which, as you now see, is flat only at top.

"Next, look at those little yellow things in the middle of the flower, and which, as I have told you, are all so many flowers; if the flower is sufficiently advanced, you will see some of them open in the middle, and even cut into several parts.

"These are monopetalous corollas, which expand, and a glass will easily discover in them the pistil, and even the anthers with which it is surrounded. Commonly the yellow florets towards the centre are still rounded and closed. These, however, are flowers like the others, but not yet open; for they expand successively from the edge inwards. This is enough

to shew you by the eye, the possibility that all these small affairs, both white and yellow, may be so many distinct flowers; and this is a constant fact. You perceive, nevertheless, that all these little flowers are pressed, and inclosed in a calyx, which is common to them all, and which is that of the Daisy. In considering then the whole Daisy as one flower, we give it a very significant name, when we call it a *composite flower*. Now, there are many genera and species of flowers formed, like the Daisy, of an assemblage of other smaller flowers, contained in a common calyx. This is what constitutes the sixth tribe, of which I proposed to treat, namely, that of the *Composite Flowers*."

Thus, in his admirable gossiping manner does Rousseau set about explaining the structure of a COMPOSITE or compound flower; I shall not continue to follow him, but take my own way of illustrating the subject further; stopping, in the first place, to notice two inaccuracies into which he has fallen, in common with all writers of the same day. The cluster of little flowers or *florets*, which he calls the flower of the Daisy, although qualified by the addition of composite, leads unnecessarily to a confusion of ideas, and is much better designated by the term flower-head (or head of flowers), which it really is; the other error is that of calling the little leaves that surround the florets a calyx; he should have said they were an involucre. The word calyx strictly belongs to a single flower, and not to a collection of flowers; while involucre is precisely the term that expresses an assemblage of little leaves or bracts

round a number of flowers. You have already had an excellent instance of it in Umbelliferous plants, and this is another.

Rousseau took the Daisy to explain the structure of Composite flowers, because it is so very common a plant; but it has the defect, as a means of illustration, that its parts are so very small, as to be distinguished with difficulty, and that it does not comprehend so many points of structure as some others. For these reasons, I will recommend you to take a plant equally common in gardens in the autumn, the *French Marigold* (Tagetes patula, Plate XVII. 1.), an old-fashioned, but pretty flower, which is not liable to the same objections.

Its flower-head (*fig.* 1.) is surrounded externally by an olive green cup, formed of several bracts which have grown together at the edge (*fig.* 6.); this cup is the involucre. Next the involucre are placed several florets (*figs.* 1. & 2.), whose corolla is a broad yellow blade, rounded at the end, and striped with wide streaks of chocolate brown (*fig.* 2. *d.*); it is all turned one way, spreading away from the flower-head, and only tubular at the bottom; Rousseau says, such corollas look as if they were gnawed off on one side. Technically, they are named *ligulate*, which signifies strap-shaped, because in the greater part of Composite flowers they are long and narrow; they are also said to form the RAY of the flower-head. At the base of the tube of the corolla you will find a few little narrow hairy scales (*fig.* 2. *b.*), which stand on the top of the ovary, in the place of the calyx. Bo-

tanists choose to call them the PAPPUS; although in reality they are the calyx, which is only stunted and starved in consequence of its being developed amidst the constant pressure of the florets against each other: the pappus is often altogether absent, as in the Daisy for instance; but it sometimes forms a beautiful plume of feathers, which catches the wind and enables the seed to soar into the air, and to scatter itself to a distance. The delicate feathery balls of the Dandelion which children amuse themselves with blowing away into the air, are the fruit of that plant crowned by the pappus. Below the pappus is the ovary (*fig.* 2. *a.*), containing one single ovule; it terminates in a slender style, which passes through the tube of the corolla, and forks at the top into two stigmas (*fig.* 2. *e.*). In time the ovary becomes a dry hairy fruit (*fig.* 8.), crowned with the pappus, and containing one single seed (*fig.* 9.). Such are the *florets of the ray.*

The middle of the flower-head (*fig.* 1. *b.*), included within the ray, is called the DISK; it consists of florets constructed very differently from those of the ray. To examine them conveniently you should pull one of them out (*fig.* 3.). In the ovary you will find no difference worth naming; the pappus is also like that of the ray, only it is more perfect, and one of its scales is a sort of stiff bristle (*fig.* 3. *b.*). The corolla is of quite another kind; it is tubular from the bottom to the top; towards the top it widens, and at last separates into five little divisions which are covered all over with hairs in the inside; this

kind of floret is called *tubular*. The stigmas are two (*fig.* 7.), and project beyond the mouth of a little hollow cylinder, which is found at the orifice of all the tubular florets of the disk (*fig.* 4. *a.*). At first sight you may be at a loss to determine what the cylinder is: but if you use a magnifying glass, you will presently discover that it is formed of five anthers, which grow together by their edges, in the same manner as petals grow by theirs, when they form a monopetalous corolla. It is easy to slit this cylinder (*fig.* 5.), and then you will see that each anther has its filament, and two lobes containing the pollen.

The broad flat part, out of which the florets grow (*fig.* 6. *a.*), is called the RECEPTACLE; it is sometimes covered with scales, or hairs, or is even pitted with hexagonal depressions, which look like the cells of honeycomb. Can you guess to what, in other plants, this receptacle is analogous? for you may be sure it is only some very common part masqued and disguised, to the eyes of an ordinary observer. To understand it, you should first compare the flower-head of a composite flower, with an umbel (See Letter II.). In the latter the flowers are all on long stalks, that proceed from a common point, which is the termination of the stem or branch; their point of origin is wider than the stem itself, because of the number of stalks, for whose bases room has to be found; the stalks, however, are very slender, and do not occupy much room. But suppose the flowers of an umbel had no stalks, but were seated close upon the stem, as sometimes happens; it is obvious that as

they are much stouter than their stalks, the stem would, in such a case, have to be expanded much more in order to receive them; in fact it would become a receptacle such as you find in a Daisy. The receptacle of a composite flower is therefore an expanded part of a stem.

You may also look at its structure in another way. Take a spike of Ribgrass, an exceedingly common weed, about which I shall say something at the end of this letter; place it by the side of a flower-head of French Marigold; let the letter *e* in both cases represent the base of the inflorescence, and *b* the top of the spike of Ribgrass (Plate XVII. 2. *fig.* 1.), and the centre of the disk of the French Marigold (Plate XVII. 1. *fig.* 1.). Suppose the spike of Ribgrass to be very much shortened, the number of flowers upon it remaining the same; the distance from *b* to *e* will be proportionably diminished, and the flowers will be much more crowded. Let this shortening be carried still further, the number of flowers still remaining the same, and it is obvious that in order to make room for the flowers, side by side, the stem must expand horizontally; a receptacle will then be produced, and a little reflection will shew you that the letter *b* will then indicate precisely the same parts in both plants: the centre of the French Marigold being the same as the point of the spike of Ribgrass. The receptacle of a compound flower is therefore both a contracted and expanded stem.

With regard to the involucre, Rousseau has well observed, that it has generally the property of opening

when the florets expand, of closing when the corollas fall off, in order to confine the young fruit; and lastly, of opening again and turning quite back to give more room to the fruit, which increases in size as it grows ripe. This is particularly remarkable in the *Dandelion.*

Let us now pass from these considerations to a view of the sections into which Composite Flowers are naturally divided.

If you gather a head of *Dandelion* (Leontodon Taraxacum), you will find that both the ray and the disk are composed of ligulate florets, to the total exclusion of tubular ones. Such plants are called *Succory-headed* (Cichoraceæ), and are remarkable for their stems yielding a white milk, which, when concentrated, has a soporific quality. The other sections are destitute of this property. Here are arranged numbers of our wild flowers, such as *Goat's beard* (Tragopogon), *Sow Thistle* (Sonchus oleraceus), *Wall Lettuce* (Prenanthes), *Hawkweed* (Hieracium), and the shabby *Succory* (Cichorium Intybus), with its ragged leaves, and pale blue florets. It is also to this section that the *Lettuce* and *Endive* of the garden belong.

From the last you will easily distinguish what is called the *Thistle-headed* section (Cinaraceæ). These plants have no ligulate florets; all the florets are tubular, generally very wide at the mouth, and so much spreading beyond the involucre as to give the flower-head almost an hemispherical form. The leaves of the involucre are also, in most of the species, hard and spiny. It is in this section that you will

find all the *Thistles*, *Saw-worts* (Serratula), and *Blue Bottles* (Centaurea); it is also remarkable for containing the *Artichoke* (Cynara Scolymus), the bottom of which you have probably often eaten without thinking much about Botany. The next time you have one on the table, remember that the *scales*, which you suck are the involucre, the *bottom* is the receptacle, and the *choke*, which is thrown away, is a collection of florets, separated from each other by numerous stiff hairs, growing out of the receptacle.

The third section has heads composed of both sorts of florets; tubular ones in the disk, and ligulate ones in the ray; hence they are called *Radiate* (Corymbiferæ). It sometimes happens that these have no ray, and then the young student might naturally confound them with the Thistle-headed section; but this need not be done if you remark that the florets of the Thistle-headed section are very wide in the mouth, and spread over the sides of the involucre, the scales of which are usually hard and spiny, while the florets of the Radiate section are narrow in the mouth, and not longer than the scales of the involucre, which are usually soft and leafy. A very little practice will soon prevent your falling into any such error. By far the greater part of Composite flowers belong to the Radiate section; *Sunflowers*, *Asters*, *Daisies* (Bellis), *Chrysanthemums*, *Marigolds*, *Wormwood* (Artemisia), *Cudweed* (Gnaphalium), *Coltsfoot* (Tussilago), *Groundsel* (Senecio) and *Chamomile* (Anthemis), with thousands of others, for this section is of prodigious extent, form a most striking feature in the vegetable kingdom.

When we were talking of Umbelliferous plants I cautioned you against committing the error of supposing that all plants with their flowers in umbels belonged to that natural order. In like manner I must now explain to you that although the arrangement of florets in heads is universal in Composite flowers, yet that there are many plants in the world whose florets are placed in the same manner, but which do not belong to this tribe. For instance, *Eryngo*, which is an Umbelliferous plant, has its flowers in heads, so has *Sanicle*, another genus of the same order; and *Teasel* (Dipsacus) and *Scabious* (Scabiosa) are so extremely like Composite flowers in appearance, that you would never suspect them of being strangers of another family, if you were not apprized that no plants belong to the tribe of Composite flowers, which have not their *anthers united into a cylinder*. This it is which, taken with the disposition of the florets in heads, alone gives a positive character to the plants I have been speaking of. This remembered, you are mistress of the key to six or seven thousand species.

A few words upon the plant called Ribgrass, to which I have already alluded, and I pass at once to my promised analysis of the Monopetalous Dicotyledonous orders.

Ribgrass (Plantago) is a weed common at the foot of walls, by the side of pathways, and in moist places generally. It derives its name from its leaves having remarkably strong ribs passing from the bottom to the top: it has no apparent stem, but the leaves lie flat on the ground. The flowers (Plate XVII. 2. *fig.* 1.)

are white and green, disposed very closely in a long spike, and remarkable for their long stamens, the filaments of which soon become too weak to support the heavy anthers. Each flower has a hollow bract on its outside (*fig.* 2. *b.*), and a calyx of four green sepals, which are also concave, and overlie each other very much at the edges. The corolla is a thin, almost transparent, greenish-white body, divided at the end into four lobes (*fig.* 2. *c.*) which fall back on the sepals. Four stamens arise from the tube of the corolla, bearing on their filaments inverted arrow-shaped anthers. The ovary (*fig.* 6.) contains two cells, in each of which are many seeds (*figs.* 7, 8.), but it terminates in a simple hairy stigma; on this account it is considered to be formed of a simple carpel, notwithstanding its two cells. In the course of time, the receptacle of the ovules separates from the sides of the ovary, and becomes covered all over with seeds of a pale chesnut colour (*fig.* 10.); at the same time the style drops off the ovary, which changes to a little hard dry brown case or capsule (*fig.* 9.), surrounded with the sepals, and separating transversely into two parts, by giving way at its base.

These characters entitle the Ribgrass to be considered the representative of a very distinct, although very small natural order, called the *Ribgrass tribe;* which is, however, of too little importance to make it worth detaining you longer about it.

Now let us again consider the most essential distinctions of the Monopetalous orders, I have recommended

to your study. Although they form only a part of what really exist, yet a clear knowledge of them is a great step towards that of the remainder. I think the distinction will be sufficiently well expressed in a tabular form, without any preliminary explanation, beyond this, that the number of the carpels, out of which the ovary is formed, is the most important fundamental distinction to employ.

* Ovary formed of more carpels than two.

- Ovary split into four lobes
  - Flowers regular—*The Borage tribe.*†
  - Flowers irregular—*The Mint tribe.*†
- Ovary not split into lobes
  - Erect bushes—*The Heath tribe.*
  - Climbing plants—*The Bindweed tribe.*

** Ovary formed of two carpels.

- Ovary inferior
  - Milky plants
    - Anthers all separate—*The Harebell tribe.*
    - Anthers all united—*The Lobelia tribe.*
  - Not Milky plants
    - Leaves without stipules—*The Honeysuckle tribe*
    - Leaves with stipules—*The Coffee tribe.*
- Ovary superior
  - Flowers irregular . . *The Foxglove tribe.*
  - Flowers regular
    - Stamens two . . *The Olive tribe.*
    - Stamens five
      - Leaves opposite ribbed — *The Gentian tribe.*
      - Leaves alternate — *The Night-shade tribe.*

*** Ovary formed of only one carpel.

- Anthers united in a cylinder . . *Composite Flowers.*
- Anthers distinct . . *The Ribgrass tribe.*

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† I hope the learned reader will pardon my having placed these two orders among those whose ovary is formed of more carpels than two. My reason for doing so is that they seem as if so constructed, and it would be difficult to make a beginner understand that they are not.

EXPLANATION OF PLATE XVII.

I. Composite Flowers.—1. Half a flower-head of *French Marigold* (Tagetes patula); *a* florets of the ray; *b* florets of the disk; *c* section of involucre; *d* receptacle; *e* flower-stalk.—2. A floret of the ray; *a* ovary; *b* pappus; *c* tube, and *d* blade of the corolla.—3. Floret of the disk; *a* ovary; *b* pappus; *c* corolla.—4. Cylinder of stamens.—5. The same slit open and unrolled.—6. Half an involucre; *a* the receptacle.—7. The two stigmas.—8. A grain, ripe and crowned by the pappus *b*.—9. A section of a seed, shewing the embryo.

II. The Ribgrass Tribe.—1. A spike of flowers of *Broad-leaved Ribgrass* (Plantago major).—2. A separate flower; *a* the calyx; *b* a bract; *c* the corolla.—3. A section of the calyx to shew the relative position of the sepals to each other; *b* the bract.—4. A sepal.—5. An anther with a part of a filament.—6. A pistil.—7. An ovary cut perpendicularly.—8. The same divided horizontally.—9. A ripe fruit invested by its calyx.—10. A cluster of seeds upon the receptacle, as they are left when the shell of the fruit falls off.—11. A seed.—12. The same cut through to shew the embryo.

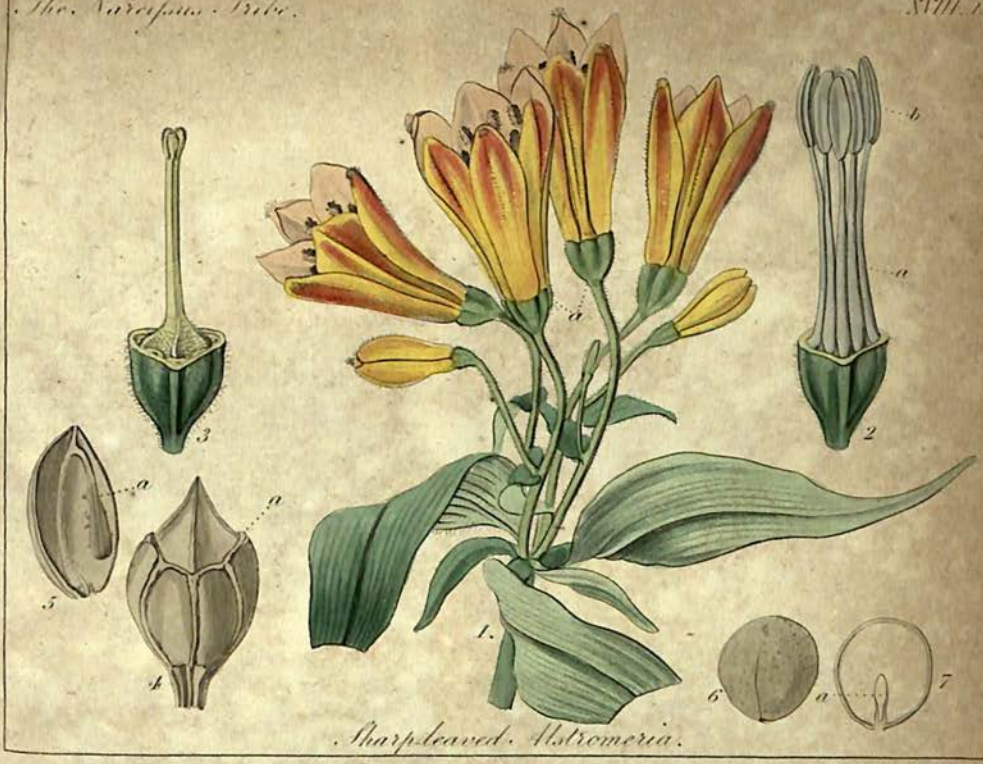
LETTER XVIII.

DISTINCTIONS OF EXOGENOUS OR DICOTYLEDONOUS, AND OF ENDOGENOUS OR MONOCOTYLEDONOUS PLANTS—THE NARCISSUS TRIBE—THE CORNFLAG TRIBE.

(Plate XVIII.)

In my last letter I took leave of Dicotyledonous plants, whieh I am persuaded you are by this time able to recognize by their general aspect, as well as by the technical distinctions to which I have chiefly called your attention. It is not their netted leaves, nor the concentric circles in their stems when woody, nor the two-seeded lobes of the embryo alone, by which they are known, but also other characters in combination with those. Their leaves are usually jointed with the stem, so that they are thrown off at certain seasons: in deciduous trees in the autumn, in evergreens in the spring or summer; their flowers, if perfect, or nearly so, are mostly divided by four or five; that is, have four or five sepals, and four or five petals, either distinct or combined; and finally, their mode of growth is, in general, by branching repeatedly to form round-headed trees, or broad spreading bushy herbs. All these circumstances are characteristic of Dicotyledonous plants; but most of them are occasionally subject to exceptions. When exceptions occur in regard to any one circumstance,

The Narcissus Tribe. XVIII. 1.



Sharp-leaved Alstromeria.

The Cornflag Tribe. XVIII. 2.

Ferraria.

attention should then be paid to others, for the purpose of ascertaining, whether, although a plant may appear in some one point of structure not to be Dicotyledonous, it may not upon the whole possess the characters of that great division. For instance, the common garden Pink, has leaves which are not netted; you might suppose on that account that it is not Dicotyledonous; but when you find that it is a branching plant, with five divisions of the calyx, five petals, and ten stamens, you may be sure that it is Dicotyledonous, notwithstanding the apparent deviation of the leaves from the general rule of structure.

All this will be more clear to you, when you become acquainted practically with MONOCOTYLEDONOUS plants; which are quite different things. They often shoot up into the air without any branches, and consequently have a sharp-headed appearance when they form trees; there is only one seed-lobe to their embryo; and their stem has no trace, whatever, of concentric circles; on the contrary, it presents, when cut across, one uniform dotted surface, as you may see if you take a piece of the common *cane*, which is split for the bottoms of chairs, and which is in reality the stem of a sort of Palm. Instead of enlarging their stems by the addition of new wood to the outside of the old, Monocotyledonous plants only add new matter to the centre of that which previously existed, on, which account they are named ENDOGENOUS (or growers inwardly). The veins of their leaves run in nearly parallel lines from the base to

the point of the blade, without branching, or forming a kind of net work, as in the leaves of grasses or lilies; so that in this respect they are immediately known from Dicotyledonous plants. Their flowers, moreover, are almost always divided by three, instead of by four or five; you will, for instance, generally find three sepals, and three petals, and three, or twice three stamens, and an ovary made up of three carpels; so that there are abundant means of distinguishing Monocotyledonous plants, whether you have only their stem, or their leaves, or their flowers, or even their fruit to examine. Now just observe, how important this is; suppose you saw a simple-veined leaf of some plant, and nothing further; although you might not be able to tell the name of the plant which bore the leaf, nor even its natural order, yet you would know that its stem must have grown by addition to its inside, that its embryo had only one seed-lobe, and that its flowers would in all probability be divided into three sepals, and three petals. Nor is this all; nearly the whole of Monocotyledonous plants are harmless; the chances would therefore be, that your leaf belonged to some harmless plant; and if it were the leaf of a tree, you would be perfectly certain that it came from some hot climate; for no Monocotyledonous trees are found in cold countries. The inspection of a mere leaf would therefore lead you to a number of useful and interesting conclusions, at which you could never arrive if you studied Botany according to an artificial system.

As much of the facility of distinguishing Monocotyledonous from Dicotyledonous plants depends upon a familiarity with the appearance of their leaves, let me recommend you, before we proceed any further to procure those of Corn or Grass, of the Pine Apple, the Hyacinth, the Tulip, or the Daffodil, and compare them with any of the Dicotyledonous plants, you are now familiar with. In the meanwhile I will sketch a comparative view of Monocotyledonous and Dicotyledonous plants, which you can afterwards study at your leisure.

DICOTYLEDONOUS PLANTS.	MONOCOTYLEDONOUS PLANTS.
Stems generally branched, & when old covered with cracked bark.	*Stems* generally quite simple; and when old covered with smooth bark.
Wood, consisting of concentric circles; the central part the oldest and hardest; the bark connected with a central pith, by means of thin plates called medullary rays.	*Wood,* not consisting of concentric circles; the central part the youngest and softest; the bark not connected with a central pith by means of medullary rays.
Leaves, with veins arranged in a netted manner; usually jointed with the stem.	*Leaves,* with simple parallel veins, which are not netted; usually not jointed with the stem.
Flowers, usually with the parts arranged in fours or fives.	*Flowers,* usually with the parts arranged in threes.
Embryo, with two or more seed-lobes, or cotyledons.	*Embryo,* with only one seed-lobe, or cotyledon.
Found wild as trees all over the world, except in the very highest latitudes.	*Found wild* as trees only in hot climates, and chiefly within the tropics.

These preliminary observations will, I trust, have conveyed to you some general notions of the nature

of Monocotyledonous plants: among which you will find that many of the commonest and most useful tribes are arranged. You will scarcely, however, have suspected that Lilies, and Palms, and Bananas, with Hyacinths, Squills, Daffodils, and Orchises, were associated with Grasses, Rushes, and Sedges; the natural affinity of all these is what we have now to study. In order to entice my young friends onwards, and to prevent their getting weary of their pursuit at a time when I am most anxious that their attention should be fixed, I shall begin with a natural order, the species of which are so generally admired, that I am sure they will wish to understand it botanically.

The *Daffodil*, called by Botanists Narcissus, represents a group of plants, having fine gay flowers, and long narrow strap-shaped leaves arising from bulbs which grow under ground. It is called in English the *Narcissus tribe*. We will not, however, take the Daffodil to illustrate it, for reasons that I shall mention by and bye. A beautiful Chilian plant, called the *sharp-leaved Alstromeria*, of which I send you a drawing (Plate XVIII. 1.), and which is now not very uncommon in gardens, will shew you the general structure of this tribe in a more satisfactory manner.

Its leaves are of a firm and rather fleshy texture, gradually tapering to the point, and are filled with simple veins. It has an inferior ovary (*fig.* 1. *a.*) with three angles, three cells, and many seeds in each cell. From the upper end of the ovary rises a richly coloured reddish-orange calyx of three sepals, inside

which are three orange-coloured petals, shaped exactly like the sepals; these are all rolled together so as to form a kind of bell. The stamens (*fig. 2. a.*) are six, and are remarkable for bearing blueish-purple anthers; a very uncommon colour for those parts. From the top of the ovary springs a three-cornered style, terminated by a three-lobed stigma (*fig. 3.*). Finally, a dull greenish-brown capsule is ripened, which is marked externally by six ribs (*fig. 4.*), and a horizontal line, which indicates the place whence the calyx, corolla, and stamens fell; when perfectly ripe it separates into three concave valves (*fig. 5.*), each of which carries away with itself a portion of the receptacle (*a.*) of the seeds. The seeds are spherical (*fig. 6.*), and consist of a great mass of albumen, in which lies a little cylindrical embryo (*fig. 7.*). This form of embryo is the most common in Monocotyledonous plants. Its upper end is the cotyledon, its lower the radicle, and the plumule or rudiment of a stem lies concealed in the former.

Of these characters a part is confined to the genus Alstromeria, and a part peculiar to the Narcissus tribe. The latter is briefly this: *an inferior ovary, calyx and corolla of the same form, and six stamens (or more).*

To this definition answers the Daffodil in all respects; but it has, in addition, a long cup, which is a row of abortive stamens; and this circumstance marks its genus. Some very fragrant hot-house plants, called Pancratiums, or *Sea-side Lilies*, also have a

cup, but their anthers arise from its border, which at once distinguishes them from the Daffodil.

It is to this order that also belong the golden *Sternbergia* of autumn, the scarlet *Amaryllises* of Brazil, the *Belladonna Lilies* of the Cape, and *Crinums*, with their long and relaxed petals, sometimes of the French white, and sometimes deeply stained with crimson. *Snow-drops*, too (Galanthus), and *Snow-flakes* (Leucojum), whose names so well express their colour, the ruby-petaled *Nerines*, to which belongs the *Guernsey Lily;* and *Blood-flowers* (Hæmanthus), whose juice is a mortal poison, are all allies of the Narcissus.

We have often seen that venomous properties lurk beneath the fairest forms, and that external appearance offers no beacon to warn the traveller of the plants in which danger lies concealed. The Narcissus tribe affords another instance; the bulbs of the Daffodil are emetic, those of the Blood-flower yield a deadly gluey poison, with which the African savages smear their arrow-heads, and the bulbs of the whole tribe are suspicious. Fortunately, however, its botanical characters are so precise, that there is no difficulty in distinguishing it from all others.

So like is a *Crocus* to some of the Narcissus tribe, that a student would naturally suppose it to belong to it, especially when he found that it also had an inferior ovary, with three cells, and its sepals and petals so much alike, as to be distinguishable only by one being rather differently coloured, and placed on the outside of the other. It differs, however, in having

only three stamens instead of six, and in the anthers being turned with their faces towards the sepals, instead of towards the style; a singular peculiarity, which in this case is found to indicate a total absence of poisonous properties; so that while the Narcissus tribe is dangerous, the natural order, called *the Cornflag tribe*, to which the Crocus belongs, is perfectly harmless.

These plants vary a great deal in their general appearance, owing to the different shapes of the calyx and the corolla, and to the size of the stem, which is sometimes round and subterranean, as in the Crocus, and sometimes long, scarred, and creeping on the surface of the ground, as in the *Cornflag* or Iris; of which the *Orris root* which babies suck is a preparation, and the name a corruption. They may, however, be always known by their agreeing with the Narcissus tribe in every thing except their *three stamens with the anthers turned away from the style.* and the want of bulbs. Their leaves are also very unusually thin, and shaped like a straight sword-blade, with the edge turned to the stem, on which account they used to be called *Ensatæ*, or sword-leaved plants (Plate XVIII. 2. *fig.* 1.).

Along with the drawing of the Alstromeria you have another, which represents a most singular plant, the colour of whose flowers resembles a lizard's back. It is a native of the Cape of Good Hope, and called the *Wavy Ferraria* (Ferraria undulata). Its flowers consists of three sepals and three petals, all of which are so wavy and curly at their edges, and so much

alike that you can hardly distinguish them; below a kind of cup, formed by the union of these parts, is a long ribbed ovary (*fig.* 1. *a.*), which contains three cells and many seeds (*fig.* 6.). The three stamens are in this genus grown into a column (*fig.* 2.) like the column of a Passion-flower; but in other genera they are distinct; each at its point curves away from the stigma as if to convey its anther (*fig.* 2. *d.*) as much as possible out of the reach of it, averting from it its face (*fig.* 2. *d.*). The style is a small cylinder, divided at its end into three broad lobes (*fig.* 2. *e.*), each of which is separated into two parts (*fig.* 3.) cut cut up into five hair-like segments: these lobes are the stigmas.

In Iris, the genus from which the tribe takes its Latin name (*Iridaceæ*), the structure is more curious than in Ferraria; the three sepals are broad and spreading, and often ornamented with a beautiful feathered crest; the three petals stand erect, and curve over the centre of the flower; while the stigmas are broad richly coloured parts, resembling petals, and curve away from the centre, as in the Ferraria. At first sight you would suppose the Iris was altogether destitute of stamens; but if you lift up the stigma you will find the runaways snugly hidden beneath their broad lobes, and lying close to a humid lip through which the influence of the pollen is conveyed to the ovules. This widening of the stigma is a very common event in the Cornflag tribe; even in the Crocus it occurs, only the stigmas are so rolled up that you do not discover it until you unroll them; they are,

in fact, so much heavier than the power of the style can support, that in the Saffron Crocus, in which they constitute the substance called Saffron, they hang down on the outside of the flower like an orange tassel.

It is to this natural order that belong those countless species of Ixia, Gladiolus, Watsonia, Babiana, &c. which spring up at the Cape of Good Hope upon the commencement of the rains, and soon cover the parched and half naked karroos with a robe of the deepest green, adorned with all manner of gay and sparkling colours.

Having studied these plants in the order I have mentioned, compare them in your mind with the numerous Dicotyledonous tribes you have already become acquainted with, and see whether you can anticipate any difficulty in recognising other tribes of Monocotyledonous plants, by the external characters I have pointed out; without the slightest necessity for having recourse to the examination of their stems or seeds.

EXPLANATION OF PLATE XVIII.

I. THE NARCISSUS TRIBE.—1. A shoot of the *sharp-leaved Alstromeria* (A. acutifolia); *a* the inferior ovary.—2. An ovary deprived of calyx and corolla, but with the stamens in their place.—3. An ovary without even the stamens; shewing the style and stigmas.—4. A ripe fruit of Alstroměria psittacina *(the Parrot Alstromeria)*, just before it separates into valves; *a* the scar whence the stamens, calyx, and

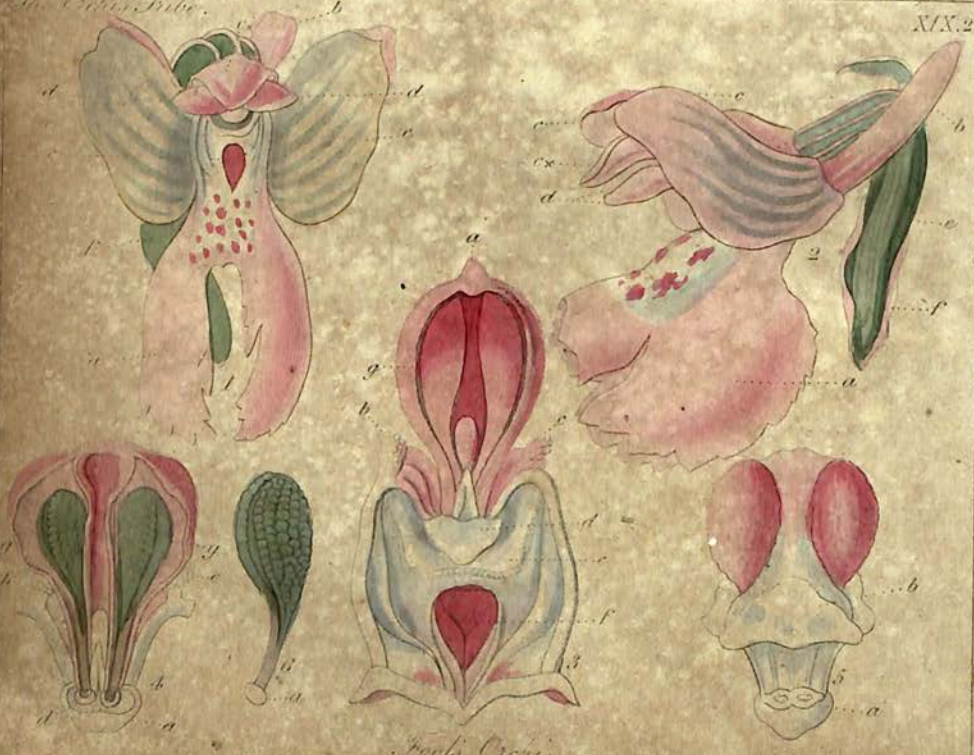
corolla dropped.—5. One of the valves, with a part of the receptacle of the seeds *a* adhering to it.—6. A seed.—7. A section of the same; exhibiting the embryo *a* lying in the midst of the albumen.

II. The Cornflag Tribe.—1. A piece of *the Wavy Ferraria* (F. undulata); *a* the ovary.—2. A column of stamens; *a* the base of the sepals and petals; *b* the column; *c* the fore part of the filaments; *d* the anthers; *e* the stigmas.—3. One of the stigmas separated from the style.—4. An anther.—5. An ovary; *a* the place whence the sepals and petals have been removed; *b* the base of the column of stamens.—6. A horizonal section of the ovary.

The Asphodel Tribe. XX. 1.

Streaked Onion.

The Orchis Tribe. XX. 2.



Fools Orchis.

LETTER XIX.

THE ORCHIS TRIBE—THE ASPHODEL TRIBE.

(Plate XIX.)

THE last natural order of Monocotyledonous plants, with an inferior ovary, which I propose to mention to you, is the *Orchis tribe*, one of the most extensive and curious of the Vegetable Kingdom. In the end of May, or beginning of June, you will meet with great numbers of a fine common species in the pastures and meadows, where they rise with their spotted leaves, and spikes of purple or rosy speckled flowers, conspicuous among the herbage that surrounds them. The country people call them Cuckoo-flowers, because they make their appearance when the cuckoo begins to call. Of these the commonest of all are the *Male Orchis* (Orchis mascula), and *Fool's Orchis* (O. Morio), either of which you may gather for the purpose of examination.

Suppose we take Fool's Orchis. It has a little fleshy root, composed of two oval knobs, and a number of succulent fibres; its leaves spread at the surface of the ground, are of a light green, of a narrow strap-shape, tapering to a blunt point, with a soft, rather fleshy texture. and the usual simple-veined structure of Monocotyledonous plants. The stem is

erect, and about nine inches high, sometimes less, but seldom more; it is covered by two or three leaves wrapped round it, so as to form a sort of sheath; at its top it bears a spike of flowers, coloured with green and white, and having the following most remarkable structure.

From the bosom of a narrow wavy lance-shaped bract (Plate XIX. 2. *fig.* 2. *f.*), springs an angular twisted body, pure green at its lower end, but often stained with red near the top (*fig.* 2. *e.*); this is an ovary, containing only one cell, and an inconceivable multitude of minute ovules, arranged in double rows upon three narrow receptacles; at its point it is gracefully bent forward, as if to present you with its singular green and pink flower.

The first thing that usually strikes an observer, is a broad roundish notched leaf (*fig.* 1. and 2. *a.*), hanging from out of a sort of casque or helmet, the two sides of which expand and retreat a little (*fig.* 1. *c. c.*), so that they may set off the lively rose colour and rich crimson blotches with their own dull green stripes; this leaf is called the LIP (labellum), and separates a little into three divisions, of which the side ones are the most notched and the largest; at its base is a hole (*fig.* 1. *e.*) which will prove, upon examination, to be the mouth of a rose-coloured horn, that seems to swing lightly behind the flower (*figs.* 1. and 2. *b.*); it is usually called the SPUR. The other leaves of the flower are thus: two are concave, spreading, a little turned in at the point, and charmingly striped with green veins, both within and with-

out (*figs.* 1. & 2. *c.*); another stands quite at the back, coloured with pure rose, and projecting forward over the lip (*figs.* 1. & 2. *c**.); below this lie two other leaves, narrower, and more delicate than the last, forming, together with it, the casque out of which the lip seems to hang (*figs.* 1. & 2. *d. d.*). These are the parts which answer to the calyx and corolla in other plants; at first sight, you will be at a loss how to determine which belongs to the one, and which to the other; and especially to know what the lip is with its spur; look, however, more attentively, and remark, firstly, that the whole number of leaves in the flower is *six;* and secondly, that *three* of them, namely, the lip, and two narrower and more delicate leaves, which form part of the casque (*figs.* 1. & 2. *a.* & *d. d.*), are placed within the three others. The first of these (*c. c.* and *c**.) form the calyx, and the last (*a.* and *d. d.*) the corolla; a very irregular one, certainly, but nevertheless conformable to all the rules of organization; as for their irregularity, *that is characteristic* of the Orchis tribe. A little study and examination by yourself, will satisfy you that this is the true view of their nature, and all the strange appearance which puzzled you at first, was caused by the unusual manner in which the sepals and petals are shaped and directed, and the disproportionate size of one of them.

The next object that is to engage your attention, is far more singular and difficult to understand. In the centre of the flower, in the place of stamens and style, just at the back of the hole that leads down

into the spur, half hidden by the petals, stands a crimson flat body (*fig.* 3.) having a deep furrow in its front. I should quite despair of explaining the structure of it, without the assistance of a drawing, which I accordingly send you: the parts are a good deal magnified, as is usual in the dissection of flowers by Botanists, in order to bring every thing distinctly into view. If you look attentively at the front of the central body (*fig.* 3. *a.*), you will remark, in the first place, that it is separated into two lobes, by a deep channel drawn down its middle; and secondly, that each lobe will open, if pressed, by a suture (*fig.* 3. *g.*) running through it from one end to the other. Pull asunder the two sides of each lobe, so as to lay open their inside (*fig.* 4.), and in each there will be seen an olive-green granular mass (*fig.* 4. *g.*), tapering gradually into a thin stalk, at the end of which is a viscid semi-transparent gland (*fig.* 6. *a.*). If you squeeze a portion of the olive-green granular mass in water, beneath a very powerful microscope, you will be surprised to see that it consists of infinite multitudes of grains of pollen sticking together in threes or fours; it is therefore a mass of pollen in a singular state; and this fact being taken as the basis of your reasoning as to the nature of the other parts connected with it, it will result as a necessary consequence, that the central body is an anther, and its sutures the lines of dehiscence, or of opening. At the foot of the anther is a pale whitish-green fleshy cup (*fig.* 3. *d.* and 4. *a.*), in which the glands at the end of the stalk of the pollen-masses are concealed; this

which is botanically called the HOOD, or pouch (cucullus, or bursicula), is peculiar to some of the Orchis tribe, and is caused by a doubling upwards of the upper edge of the stigma.

The stigma itself is a broad viscid shining space (*fig.* 3. *e.*) lying just below the hood, between it and the mouth of the spur.

These things being thus made out, it follows, you see, that the column of an Orchis is a body formed of a stamen, a style, and a stigma, all grown into one solid body; and this is the great peculiarity of the Orchis tribe. Its genera vary amazingly in the structure of the anther, the column, the lip, and indeed of all the parts, but in *the consolidation of the style and stamen.* They are all agreed. This then is the characteristic of the Orchis tribe.

If, however, there was really only one stamen, this curious natural order would be more at variance with the usual structure of Monocotyledonous plants than its conformity in the calyx and corolla would lead one to expect; and accordingly we find, that although only one stamen is perfect, there are distinct traces of two others in an extremely imperfect state. On each side of the anther, near its base, you will find a roundish granular knob (*fig.* 3. *b. c.*), which has been ascertained to be the rudiment of another anther; so that in reality the column is composed of one perfect stamen, standing between two imperfect ones; a most striking proof of the harmony of design which is manifested in all these Monocotyledonous tribes.

If you consider the mutual relation which all the parts of the Orchis bear to each other, you will scarcely fail to be struck with one circumstance above all others, namely, the apparent want of any means of communication betwen the pollen and the stigma. Not being in fine powder the pollen is not able to be scattered in the air, like that of other plants; if it were to fall out in a mass it would hardly touch the stigma; and even the possibility of this seems to be purposely prevented by the glutinous gland to which the stalk of the pollen-mass adheres, and which is itself confined within the pouch. To account for the manner in which the necessary contact between the stigma and the pollen takes place, two explanations have been given; one that insects, inserting their proboscis into the flower in search of honey, disturb and pull out, or unintentionally carry away with them the pollen-mass which sticks to them by means of the gland, and that in the latter case, buzzing from flower to flower they leave it behind them on the stigma of some neighbouring blossom; the other explanation, which has been offered by the celebrated Mr. Bauer, is that the influence of the pollen is not communicated to the stigma, by actual contact of the pollen, as is usual in other cases, but that it passes down the stalk of the pollen-mass, into the gland, and thence to the humid surface of the stigma; and he has shewn that great probability attaches to this opinion, in consequence of the existence in such plants as the Orchis itself, of a beautiful contrivance to secure such a communication. He discovered that in

the bottom of the pouch, just below the glands, are two little passages (*fig.* 4. *d.*), which open directly over exactly that part of the stigma which appears the best adapted for receiving the influence of the pollen: and that hence the pouch, which seems to the superficial observer a means of preventing communication between the pollen and the stigma, is in fact a most admirable contrivance of nature to ensure it. I leave you to form your opinion, as to which of these two explanations is the more plausible.

In this country the more common or remarkable of the wild plants belonging to the Orchis tribe, are the *Bee Orchis* and *Fly Orchis* (Ophrys), whose lips resemble the insects after which they are named; the *Man Orchis*, and the *Lizard Orchis* (Aceras), with their yellow or purple strap-like lips; *Neottia*, with her russet flowers, and scaly stems, springing from a cluster of entangled roots, which have given her the name of *Bird's Nest;* the *Butterfly Orchis* (Platanthera) with its long and taper cream-coloured lip; and the *Ladies Slipper* (Cypripedium), with its large yellow bladdery flowers, and twin anthers. They all grow on the ground in meadows, or marshes, or wood; and have always been considered the most curious and beautiful plants of a European Flora. But it is in tropical countries, in damp woods, or on the sides of hills in a serene and equal climate, that these glorious flowers are seen in all their beauty. Seated on the branches of living trees, or resting among the decayed bark of fallen trunks, or running over mossy rocks, or hanging above the head of the

admiring traveller, suspended from the gigantic arm of some monarch of the forest, they develope flowers of the gayest colours, and the most varied forms, and they often fill the woods at night with their mild and delicate fragrance. For a long time such plants were thought incapable of being made to submit to the care of the gardener, and Europeans remained almost ignorant of the most curious tribe in the whole vegetable kingdom. But it has been discovered of late years that by care and perseverance they may be brought to as much perfection in a hot-house as they acquire in their native woods, and they now, under the name Orchidaceous Epiphytes, form the pride of the collections of England.

Unfortunately they are of very little known use. *Vanilla*, which you eat in creams and other sweets, is the pod of a kind which, in the West Indies, creeps over trees and walls like ivy; and a nutritive substance called Salep is prepared from the tubercles of some kinds of *Orchis;* a most meagre catalogue of useful properties in a tribe of near two thousand species, but one to which little can be added, if we except what is called the *Shoemaker plant* (Cyrtopodium Andersonii), whose stems afford a glutinous extract employed by the Brazilians for sticking together thin skins of leather.

This order, like the two preceding has, as we have seen, an inferior ovary, a character by which they, and several others which I have not time to mention, are readily known. In your study of Monocotyledonous plants you cannot do better than take this

circumstance as a fundamental distinction from which your analysis may be continued. Let us now proceed to some orders in which the ovary is superior.

The *Hyacinth, Squill, Onion, Star of Bethlehem* (Ornithogalum) and *Asphodel,* belong to a natural order, called the *Asphodel tribe,* which is remarkable for the extreme simplicity of the structure of all its parts. Three sepals, and three petals of similar form, size, and colour, six stamens, and a superior three-celled ovary, which changes to a fruit containing seeds with a black brittle skin (Plate XIX. 1.), form the essential character, and combine a large number of plants, generally quite harmless, and in the majority of cases remarkable for either their use or their beauty. It is difficult to single out any one species better fitted than another to illustrate the Asphodel tribe, so uniform are they in the more important points of organization. I happen to have at hand the *Streaked Onion* (Allium striatum), but you may take with equal advantage the common Onion, or any of the others, I have above named, for the purpose of study.

The leaves and flowering stems of this plant, rise from a subterranean roundish fleshy body, formed of scales wrapped closely over each other. The scales are of the same nature as those of a bud, namely, the rudiments, or the bases of leaves; and the body itself, called a BULB, is a kind of underground bud; hence you will perceive that when one talks of Hyacinth *roots* which are placed in glasses, or of the *roots* of Onion, Garlic and Shallots, an incorrect kind of

language is made use of. In one respect, the bulb differs essentially from a bud: it is not a perishable part, intended merely as a protection to the young and tender vital point, from which new growth is to take place: this indeed is a part of its object, but it also serves as a copious reservoir of nutritive matter upon which the young leaves and flowers feed. On this account its scales are not thin and easily withered up, as in a common bud, but succulent, and capable of retaining their moisture during long and severe drought. In this we again see a direct manifestation of the all protecting care of the Deity; for bulbous plants are generally natives of situations which at certain seasons of the year are quite dried up, and where all vegetation would perish if it were not for some such provision as we find in the bulb; in places like the hard dry Karroos of the Cape of Good Hope, where rain falls only for three months in the year, in the parched plains of Barbary, where the ground is rarely refreshed by showers, except in the winter, and on the most burning shores of tropical India, beyond the reach of the tide, and buried in sand, the temperature of which often rises to 180°, bulbous rooted plants are enabled to live, and enliven such scenes with their periodical beauty.

You must not, however, imagine, either that all the Asphodel tribe have bulbs, or that all bulbs belong to the Asphodel tribe; of the inaccuracy of the latter notion you must already be aware, if you remember the Narcissus tribe; the former would be not less a mistake; all that I meant, in thus connect-

ing the bulbous structure with the Asphodel tribe, was that it is an exceedingly common characteristic. The Asphodel genus itself has a fleshy fingered root, without any trace of bulb, and some of the genera contain trees of considerable size.

The leaves are long narrow green straps, and have the simple parallel veins you have been led to expect. The flowering stalk rises directly from the bulb, without any intermediate stem; as it is long, and destitute of leaves, and rather different in appearance from a common flower-stalk, it is technically named the SCAPE. At its top it bears an umbel of flowers, at the base of whose long stalks are a number of membranous satiny scales, or bracts (*fig.* 1. *a.*); they are a sort of involucre, but are occasionally called a SPATHE. The three sepals are very evidently placed on the outside of the petals (*fig.* 2.), but excepting in this respect, they are absolutely the same both in colour, size, form, and direction. Of the six stamens, three are a little smaller than the others; their anthers open by two slits which are turned towards the style. The ovary (*fig.* 5.) is an oblong body, with three furrows, a single style, and a stigma which exhibits no sign of being divided. Inside the ovary you will find three cells, in each of which is a number of ovules (*fig.* 6.). Last of all comes the fruit;-a little brown dry case which splits into three valves (*fig.* 6*.), to allow of the escape of the angular black seeds, whose skin is of a very brittle nature. This last circumstance of the black

brittle coating of the seed, is one of the most important characters in the Asphodel tribe, as you will find in my next letter.

The principal differences of appearance in the Asphodel tribe are caused by two circumstances, the growing together of the sepals and petals into a tube, and the formation of a stem covered with leaves; the former alters the look of the flowers, the latter changes the whole aspect of the plant. You must therefore pay attention to this, before you discontinue your study of the tribe.

To understand the first of these two circumstances you should endeavour to trace the gradations by which the growing together of the sepals and petals occurs. In the Onion you have seen that they are all distinct; they are equally so in the *Vernal Squill* (Scilla bifolia), or in the *Nodding Star of Bethlehem* (Ornithogalum mutans); but in the wild *Blue Hyacinth*, or *Blue-bell*, as it is often called (Hyacinthus non scriptus), they converge so as to form a tube; and in the curious *Starch Hyacinth* (Muscari) they are completely glued together. These gradations exemplify most perfectly the passage from a spreading flower with separate segments to a tubular flower with all the segments united.

The second peculiarity, that of forming a leafy stem, gives a much more different aspect to a part of the tribe. In the *Asparagus*, for example, which you perhaps only know in the state in which it is brought to table, the stem when full grown is repeatedly

branched and covered with little taper green leaves; the *Asphodel* itself has a simple stem clothed with very long blueish green channeled leaves; and certain exotic plants called *Dragon trees* (Dracænas), form trees of considerable size, with stems having tufts of long broad leaves at their ends, in the manner of Palms.

The latter, however, you are not likely to meet with, unless you should travel into countries more southern than Europe; so that I do not anticipate any probability of your being embarrassed by them in your notions of the Asphodel tribe.

Our next subject will be Lilies, the most gorgeous, and Rushes the most mean, of Monocotyledonous plants.

EXPLANATION OF PLATE XIX.

I. THE ASPHODEL TRIBE.—1. An umbel of the *Streaked Onion* (Allium striatum); *a* the spathe.—2. A flower spread open.—3. An anther viewed in front.—4. The same viewed from behind.—5. A pistil; *a* the place where the sepals and petals were cut off; *b* the ovary.—6. An ovary cut through horizontally.—6*. A ripe capsule, separated into valves; *a* the remains of the flower.—7. A seed.—8. The same cut through, shewing the embryo, *a*, lying in the cavity of the albumen.

II. THE ORCHIS TRIBE.—1. A flower of *Fool's Orchis* (O. Morio) seen in front; *a* the lip; *b* point of spur; *c c* lateral sepals; *c** upper sepal; *d d* petals; *e* mouth of the spur; *f* bract covering the ovary. 2. The same viewed in profile; *a* lip; *b* spur; *c c* lateral sepals; *c* upper sepal; *d* petals; *e* ovary; *f* bract enveloping the ovary.—3. Column of Orchis Mascula; *a* the anther; *b c* abortive anthers; *d*

pouch of the stigma; *e* the glutinous face of the stigma; *f* the mouth of the spur; *g* the suture by which the lobe of the anther opens.—4. An anther with its lobes forced open; *a* pouch; *b c* abortive anthers; *d* passages in the pouch through which the pollen is supposed to communicate with the glutinous surface of the stigma; *g g* pollen-masses.—5. Back of an anther; *a* the passages in the pouch of the stigma; *b* the part where the anther was cut off.—6. A pollen-mass; *a* the gland.—(These are after drawings by Mr. Bauer.)

Eduses Tulip.

Field Luzula.

LETTER XX.

THE LILY TRIBE—THE COLCHICUM TRIBE—THE RUSH TRIBE.

(Plate XX.)

THE characters of the Asphodel tribe are so simple, that I see no probability of your misunderstanding their application in more than two cases. Let your next inquiry then be how to avoid committing those errors.

If you examine the flower of a *Tulip* (Plate XX. 1.), you will find so great a resemblance between its structure and that of the Asphodels, that you will not doubt of its belonging to their tribe. It has three sepals (*fig.* 1. *b. b b.*), which are of the same size and colour as the three petals (*c. c. c.*); from within these arise six stamens (*fig.* 2.), and in the centre of all is an ovary with three angles, three cells (*fig.* 3.), and a number of ovules in each cell. All this is quite in accordance with the structure of the Asphodel tribe. The leaves, too, are extremely similar; they are narrow strap-shaped things, with simple parallel veins; the underground bodies, moreover, from which the leaves and flowers shoot up, are true bulbs. Surely, then, the Tulip must belong to the Asphodel tribe.

If the same accordance existed in the structure of all their other parts, it is clear, that to distinguish the Tulip from the Asphodel tribe would be unnecessary; but there are distinctions in parts to which I have not yet adverted, and these distinctions are considered important.

In the first place, the flowers of the Tulip are *much larger, and more showy* than you find in the Asphodels; and secondly, its seeds have not the same hard black brittle coat; but in its room you have *a soft pale spongy integument.* These are the two points upon which Botanists rely for the separation of the Tulip and its relations.

It is to the *Lily tribe* that the Tulip belongs, together with the speckled *Fritillaries, Crown Imperials, Day Lilies* (Hemerocallis), and true *Lilies* (Lilium), *Dog's-tooth Violets* (Erythronium), and *Tuberoses* (Polyanthes), the most odoriferous of flowers.

That the Lily tribe may be easily distinguished by the large size of its flowers, must be obvious, after naming such well known plants as the above, compared with which, the Asphodels, pretty as they are, sink into comparative insignificance. But the difference would be still more striking, if we added to the list the gigantic Lilies of Nipal, one of which is described by Dr. Wallich as growing ten feet high, with flowers large in proportion.

It is, however, certain, that, notwithstanding the distinctions I have pointed out, the Lily tribe is very closely allied to that of Asphodels, with which it also coincides in its harmless qualities. We only know

its beauty; it is in the eastern parts of Asia, among the Kamtchadales, &c. that it is applied to useful purposes. By those people, the bulbs of certain Lilies are used as a common food, and are stored up as an important part of their winter stock of provisions.

The fibres of the leaves of both Asphodels and Lilies are sometimes strong enough to be manufactured into hemp. Among the former is classed the *New Zealand Hemp* (Phormium), of which such extensive use is now made in the navy; and with the latter are stationed the plants called *Adam's Needle* (Yucca), because their strong sharp-pointed leaves have been fancifully compared to a gigantic needle. A better name would have been the *Needle-and-thread Plant*, for by soaking in water, the fibres of the leaves may be separated from the pulp, without being torn from the hard sharp point, so that, when properly prepared, the leaves do really become needles, ready provided with a skein of thread.

Since both the Asphodel and Lily tribes are so generally harmless, it becomes highly important that all possibility of confounding them with a poisonous order, which they in some respects resemble, should be guarded against. *Meadow Saffron*, called by Botanists Colchicum, *White Hellebore* (Veratrum), and some other plants, have a structure very analogous to theirs. A calyx and corolla, each of three leaves of similar form and texture, half a dozen stamens, and a superior three-celled ovary, also characterise in part the natural order called the *Colchicum tribe*, to which

those plants belong. Colchicum itself is very like a Crocus in flower, but its superior ovary prevents its being confounded with the tribe in which the Crocus is included. The species of Melanthium and Helonias are so similar in appearance to many of the Asphodel tribe, that they would no doubt be referred to the latter by a young Botanist. They, however, Meadow Saffron, and all the rest of the Colchicum tribe, may be recognised at once by three marks; in the first place, they have no bulbs, but in their stead a solid knob or subterranean stem; secondly, their anthers are turned away from the stigma, splitting, and emitting their pollen on the side next the petals; and lastly, the three carpels out of which the three-celled ovary is constructed, are separated at their points, so that there are always three styles instead of one style. These signs are what you must trust to in your determination of the Colchicum tribe; they may appear slight, and you may wonder why such trifling distinctions should serve to distinguish poisonous from wholesome orders; but with considerations of the causes of such a fact, we have no concern; all that it imports us to know is, that Providence has distinguished them by such minute marks, and has thus provided man with safe and unerring guides, if he will but learn how to follow them.

Between many other tribes of Monocotyledonous plants the distinctions are no stronger than those we have already examined, a proof of which I am now about to give you.

Rushes have so little apparent resemblance to Lilies, or Asphodels, or Meadow Saffron, that no one would ever dream of placing them all in the same natural group; and yet, if you examine a Rush, you will be surprised to see how slight is the difference that really exists between them. Some Rushes are humble rigid leafless herbs, with stiff slender wiry stems, and little clusters of dingy flowers: others are still more dwarfish in stature, but have well formed leaves. An exceedingly common plant of the latter description is the *Field Luzula* (Luzula campestris, Plate XX. 2.). From a fibrous root rises a stem not more than five or six inches high, and which you can hardly distinguish from the grass that it generally grows among in the meadows. Its leaves are narrow and grassy, and clothed with remarkably long hairs. At the top of the stem grow a few heads of chesnut-brown flowers, the structure of which you will hardly make out, except the sun shines, for it is then chiefly that the parts unfold. But if at that time you watch one of the brown clusters, you will be able to perceive, that each flower has six chesnut-coloured leaves, which spread like a star (*fig.* 3.), of which three are sepals, and three are petals. On their outside are two or three bracts (*fig.* 2. *a. a.*), so like them, as to be only distinguishable by their position. From within the flower rise six stamens; and from between the latter an ovary (*fig.* 4.) with three angles, one style, and three stigmas. It fruit (*fig.* 5.) is an ovate body, containing only one cell, and three seeds (*fig.* 6. 7.), with a pale soft skin.

Now you will observe that in all that relates to the sepals, petals, and stamens, there appears to be nothing to distinguish a Rush from the Asphodel tribe; the fruit would seem essentially different, because of its having only one cell; but in the *true Rushes* (Juncus) the fruit has three cells, so that that difference is unimportant. In fact if we neglect the texture, colour, and imperfect degree of developement of the calyx and corolla, there will be hardly any means of separating Rushes from Asphodels, except the softness of the skin of their seeds. That the former do represent an inferior order of vegetation, there can, however, be no reasonable doubt; we accordingly consider them among the most imperfect of regular Monocotyledons, Asphodels being an intermediate degree of developement, and Lilies the highest degree.

Rushes are of so little use in any of the ordinary affairs of life, that it is scarcely worth occupying more time with their study. The plants from whose stems are made what are called rush-bottomed chairs, rush-mats, and the like, are usually species of *Club-Rush.* and belong to the Sedge tribe, to which we shall now come very shortly.

The orders of Monocotyledonous plants which we have examined, and several others that have not been mentioned, form what may be considered a natural subdivision, characterised by the perfect and complete manner in which their flowers are organized. In no case do they exhibit fewer than six divisions, of which three belong to the calyx, and three to the

corolla. If you examine with care the distinctions by which they are separated from each other, you will find that they are of this nature.

- Ovary inferior
  - Stamens & style separate
    - Stamens 6—*The Narcissus tribe.*
    - Stamens 3—*The Cornflag tribe.*
  - Stamens and style grown together into a solid column . . . . . *The Orchis tribe.*
- Ovary superior
  - Anthers with their faces turned towards the ovary. Carpels firmly united.
    - Seed-coat, soft and pale. Flowers large. — *The Lily tribe.*
    - Seed-coat black and brittle. Flowers middle sized. — *The Asphodel tribe.*
    - Seed-coat soft and pale. Flowers minute, brown and dry — *The Rush tribe.*
  - Anthers with their faces turned away from the ovary. Carpels partially separate — *The Colchicum tribe.*

EXPLANATION OF PLATE XX.

THE LILY TRIBE.—1. Leaf and flowers of *Ecluse's Tulip* (Tulipa Clusiana); *a* bract; *b* sepals; *c* petals.—2. Stamens and ovary.—3. The ovary cut through horizontally, shewing the ovules.

II. THE RUSH TRIBE.—1. Stem, leaves, and flowers of the *Field Luzula* (Luzula campestris).—2. A flower separate; *a a* bracts.—3. An expanded flower seen from above.—4. A pistil, with its single style and three stigmas.—5. A ripe fruit.—6. A seed.—7. The same cut through perpendicularly.

LETTER XXI.

THE BULLRUSH TRIBE—THE ARROW-GRASS TRIBE —THE DUCKWEED TRIBE.

(Plate XXI.)

In my last letter I mentioned that all the orders we have hitherto examined among Monocotyledonous plants have their flowers organized in a complete and perfect manner. This letter will relate to some that are incomplete and imperfect. You will find that there are three degrees of organization in Monocotyledons, of which we have passed over one, are about to enter upon a second, and shall very soon arrive at the third.

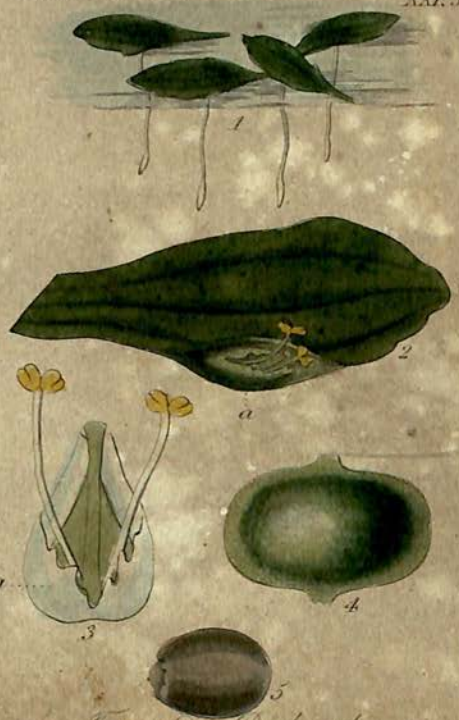
Bullrushes (Typha) are narrow flat-leaved tall plants, growing in marshes or pools of stagnant water, having their stems terminated by a dark cylinder, surmounted by a more slender yellow spike. These plants represent a natural order, named after them, the *Bullrush tribe*, to which belongs a common wild marsh plant, called *Bur-reed* (Sparganium). The latter will furnish you with the means of studying the peculiarities of the natural order.

If you regard the Bullrush ever so attentively, you will fail to discover, at any period of its growth, a

The Bulrush Tribe. XXI. 1.

Branching Bur-reed.

The Duckweed Tribe. XXI. 3.



Furrowed Duckweed.

The Arrow-grass Tribe XXI. 2.

Marsh Arrow-grass.

trace of flowers like those of the plants that have gone before. Upon the whole surface of the plant you find nothing different from leaves, except the dark cylinder, and the yellow spike on the top of it. It is at these parts that in reality the flowers are collected; but they are so minute, and their organs are so delicate, that it requires a microscope, and a careful separation of them, to determine their real nature. The dark cylinder consists wholly of flowers containing pistils only, or being fertile, and the yellow spike is composed of flowers containing nothing but stamens, or being sterile. I do not, however, propose to fatigue you by obliging you to anatomize a Bullrush; the same purpose will be effected, if you take the *Bur-reed*, which is similar in structure, but larger in all its parts.

Branched Bur-reed (Sparganium ramosum, Plate XXI. 1.), is a wild plant, frequently found growing in ditches or pools, or by the wet banks of rivers. It rises to the height of two, or even three feet, and branches from the very ground. Its leaves, which are narrow, and shaped like a short straight sword-blade, have near the top of the stem a remarkably broad sheathing base. At the extremities of the branches appear round balls of flowers, some of which (*b. b. fig.* 1.), are bright green, and others (*a. a.*) bright yellow; the latter being the most numerous, and placed above the others. The yellow heads consist of stamen-bearing, or barren flowers, and the green heads of pistil-bearing, or fertile florets. What happens in this case, occurs also in all instances in

which the stamens are separated from the pistils in different flowers on the same plant; we invariably find that the stamens are placed on the uppermost parts of the branch above the pistils, an arrangement which is no doubt provided, to facilitate the scattering of their pollen upon the stigmas. If they were placed below the pistils, it would be much more difficult for the pollen to reach the stigma, and consequently, the great end of the creation of the stamens would be almost frustrated. We find, however, that every thing is foreseen, and provided for by Providence, with the same care in these little plants, as in the most exalted and perfect of the works of nature; and that even so apparently useless and insignificant a weed as the Bur-reed, contains the most convincing evidence of the worthlessness of the opinions of those who, denying the existence of the Deity, would have the world believe that living things are the mere result of a fortuitous concourse of atoms, attracting and repelling each other with different degrees of force.

If we open one of the yellow balls, we find it consists of a great number of separate flowers, each of which has a calyx of three long-stalked jagged sepals (*fig. 2. a. a. a.*), and six wedge-shaped anthers, which are heavier than the little slender filaments can well support.

In the structure of their calyx, the flowers of the green heads do not materially differ from the latter (*fig.* 3.), the sepals are three in number, but broader and shorter, rolled round the pistil, and seated close

upon the receptacle, without any stalk. The pistil is an oval body, terminated by a deeply lobed stigma (*fig.* 3.), and having in its ovary but one cell, from the summit of which hangs a single ovule. The fruit contains one seed (*fig.* 6.), consisting of a mass of albumen (*fig.* 7.), at the further end of which lies a minute embryo (*fig.* 8.).

It is obvious that this is an organization much more imperfect than that of the Monocotyledonous orders we have before examined; in room of an evident calyx and corolla, we have nothing but three scales, there is no trace of the number three in the ovary, and the stamens and pistils are separated from each other. In the Bullrush itself, the imperfection is yet greater; even the scales, which in the Bur-reed represent the calyx, are wanting, and no hing appears in their room but a quantity of delicate black hairs.

Nearly allied to the *Bullrushes*, like them useless to man, as far as we know, and equally inhabiting wet and spongy soils, are some little inconspicuous plants, called by the learned *Triglochin*, and by others *Arrow-grasses*. These, and some allied genera, form an order called the *Arrow-grass tribe* (Juncagineæ, Plate XXI. 2.), in which incompleteness of structure exist in a less degree than in the Bullrushes, for they have a calyx and corolla, and the usual number of stamens; but the former are more like scales than sepals and petals, and the ovary, although it has the usual ternary structure of Monocotyledons, is nevertheless in an imperfect state.

Marsh Arrow-grass (Triglochin palustre), is a little

inconspicuous plant, which does not grow above eight or nine inches high, and, both its leaves and stems being remarkable slender, is easily overlooked. Its curious structure will, however, amply repay the trouble of finding and examining it. It is common enough in wet meadows, or in other moist places, where the ground is covered with a sward of grass, from which you will never distinguish it, without employing all your power of observation. It is said to send out scaly runners, which end in little knobs, shaped like a scorpion's tail. Its very narrow succulent leaves are of just the length and colour of those of many grasses, but they are taper, and not flat. When about to flower, it throws up from the midst of its leaves a little slender undivided stem (*fig.* 1.), which bears at its upper end a good many green flowers, loosely arranged at some distance from each other. Each of these flowers is constructed thus: On the outside are three concave blunt scales (*fig.* 2. *a. a. a.*), which constitute the calyx; in the cavity of each of these there lies a roundish anther (*fig.* 4. *b.*), the face of which is next the scale, and consequently in the most unfavourable position possible for discharging its pollen upon the stigma. Within the calyx are three other scales, which are pressed close to the ovary, and which in like manner contain three anthers in their hollows; these scales are the petals; so that an *Arrow-grass* has three sepals, three petals, and six stamens. Its ovary is a long three-cornered body, having no style, and for a stigma nothing but a tuft of little hairs (*fig.* 2.

& 3. *b.*). It may be separated with care into three carpels, at the bottom of each of which lies a single erect ovule, a great deal smaller than the cavity in which it is placed (*fig.* 3.). The fruit is a narrow three-cornered dry case, which divides into three slender parts, each of which is partly filled with a taper seed (*fig.* 7.). In almost all Monocotyledonous plants, a considerable quantity of albumen is provided for the nutriment of the young embryo, but the *Arrow-grass tribe* is one of those which form an exception to this rule. The embryo of these plants lies immediately below the seed-coat, and consists of a cotyledon (*fig.* 8. *c.*), having near its base a small slit (*a.*) through which the young stem is protruded when the plant begins to grow.

It is evident that this kind of structure is so unlike what we find in the Bullrushes, as to require no further explanation. What does require elucidation is the reason of the singular arrangement of the anthers, which I have just described; it does not at all appear for what cause they are so carefully embodied in two hollows of the calyx and corolla, nor indeed how, under such circumstances, their pollen is ever to reach the stigma. I must confess my inability to explain the matter: you cannot do better than reflect upon it, until you hit upon some solution of the mystery.

Far more simple than the previous tribes is that to which the *Duckweed* (Lemna) gives its name. In the former, whatever deficiency there might be in the parts of fructification, there was at least a stem and

leaves. But in Duckweed there is nothing but a fleshy floating green body, which looks like a green scale, and which is in reality a compound of both root and stem. Most people fancy that Duckweed never flowers: and many are they who have watched it all their lives without succeeding in discovering its blossoms. If, however, you will fix your eyes attentively upon a mass of it, on a still sunshiny day in the months of June or July, you will probably discover exceedingly minute straw-coloured specks here and there on the edges of the plants; they have a sparkling appearance, and notwithstanding their minuteness readily catch the eye. These are the anthers, and they being found, you have only to carry home the plants, and place them under a microscope, when all the secrets of their flowering stand revealed. Where the anthers have caught the eye, will be seen a narrow slit, out of which they peep; if you widen this slit (Plate XXI. 3. *fig.* 2.) with your dissecting instruments, you will be able to extract the blossom entire (*fig.* 3.); and you will have before your eyes the simplest of all known flowers, as Duckweed itself is the simplest of all known flowering plants. The flower consists of a transparent membranous bag, shaped like a water caraffe, and split on one side; within it are two stamens, and one ovary with a style and simple stigma. The fruit (*fig.* 4.) contains but one cell, in which are one or more seeds (*fig.* 5.) its shell is a thin cellular integument.

Such are the simple means that Duckweed possesses of propagating itself; means, however, which

appear to be abundantly sufficient, if we are to judge from the immense quantities which rise every year to the surface of our ponds. In Europe we have no other plant belonging to the same natural order; but in tropical countries its place is occupied by a plant called *Pistia*, which is a sort of gigantic Duckweed, with broad lobed leaves like some Lichens, and a more highly organized flower.

With these examples of imperfect Monocotyledonous plants, I must dismiss that part of the subject; in my next letter I shall introduce you to the more interesting and important tribes which furnishes us with bread.

EXPLANATION OF PLATE XXI.

I. THE BULLRUSH TTIBE.—1. A shoot of *Branching Bur-reed* (Sparganium ramosum); *a a* heads of barren flowers; *b b* heads of fertile flowers.—2. A barren flower; *a a a* sepals.—3. A fertile flower.—4. An anther seen from the side.—5. The same viewed from the edge.—6. A seed.—7. The same divided perpendicularly, with the embryo in one end of the albumen.—8. The embryo extracted.

II. THE ARROW-GRASS TRIBE.—1. A flower-spike of *Marsh Arrow-grass* (Triglochin palustre.)—2. A flower; *a a a* sepals; *b* stigma.—3. A perpendicular section of one of the cells of the ovary; *b* stigma.—4. A scale of the calyx *a;* with the anther, *b*, lying in it.—5. An anther seen on the side by which it discharges its pollen.—6. A ripe fruit.—7. A perpendicular section of one of its cells, shewing the manner in which the seed lies in it.—8. An embryo; *a* the slit through which the stem is finally protruded; *b* the radicle; *c* the cotyledon.

III. THE DUCKWEED TRIBE.—1. Plants of *furrowed Duckweed* (Lemna trisulca) floating on water.—2. A plant magnified, and in flower at *a*.—3. A flower extracted from the slit in which it laid; *a* the membranous bag.—4. A fruit.—5. A seed.

LETTER XXII.

GLUMACEOUS PLANTS—THE GRASS TRIBE—THE SEDGE TRIBE.

Plate XXII.

For the natural orders forming the two different degrees of developement we have now considered, there is no collective name; but for the third we have one in such general use, that we must not pass it by in silence.

There are certain plants which are called Glumaceous, because in place of calyx and corolla they have nothing but green or brown scales, named *glumes*, arranged alternately round a common centre. The most remarkable of such plants are Grasses and Sedges, to the former of which I propose first to call your attention.

The most common and the most useful of all the natural orders of plants is beyond doubt the *Grass tribe;* wherever we cast our eyes, we are sure to see blades of grass springing up, if any vegetation at all can exist; it is they that form that universal verdure which gives the northern parts of the world their peculiar charm, and which alone may console the inhabitants for the want of those other advantages

The Grass Tribe. XVII. 1.

Soft Brome Grass.

The Sedge Tribe. XXII. 2.

Hairy Sedge.

which a brighter sun and more cloudless sky are capable of supplying. Bread is exclusively prepared from the flour or albumen of the seeds of various kinds of corn, chiefly from wheat, and the richness of pastures depends essentially upon the species of Grasses that inhabit them. If it were not for the creeping subterranean stems of maritime Grasses, which can vegetate amidst dry and drifting sand, the banks which man heaps up as a barrier against the ocean would be blown away in the first hurricane; but the *Sea-reeds* (Ammophila), *Lyme-grasses* (Elymus), *Wheat-grasses* (Triticum), and others, vegetate rapidly on such embankments, and, piercing the soil in every direction with their tough underground stems, presently form an entangled web of living matter, which is spontaneously renewed as fast as it is destroyed, and which offers a resistance to the storm which is rarely overcome. Finally, the Bamboo alone is capable of supplying all the wants of savage man; with its lightest shoots he makes his arrows, thin strips of the wood form bow-strings, and from the larger stems he fabricates a bow; a long and slender shoot affords him a lance shaft, and he finds its hardened point a natural head for the weapon. With the larger stems he builds the walls and roof of his house: its leaves afford him an impenetrable thatch; split into narrow slips it gives him the material for weaving his floor mats, and other articles of domestic convenience; its fibre furnishes him with twine, and its leaves provide him with paper, when he becomes sensible of the utility of such a material.

Would he commit himself to the waves, the stems form the hull of his boat, which a few skins stretched over it render water tight; they also give him masts; and thin slips of wood become cordage or are woven into sails.

In tropical countries Grasses are far more gigantic than in England; we usually see them at their largest, two or three feet high, when in flower in the hay fields; and the reeds that in marshes or ponds gain a stature of seven or eight feet, are probably the noblest specimens of the tribe with which you are acquainted. But in equinoctial regions, where the air is damper, and the sun far more powerful and brilliant than with us, Grasses acquire such surprising dimensions as to rival Palms themselves in majesty of appearance. In Brazil we are told that the hay will grow seven or eight feet high, the *Sugar-cane plant* (Saccharum) averages 20 feet, and *Bamboos*, with their light imperishable stems, lance up into the air to the height of 30 or 40 feet. It is in such regions alone that we can really behold the perfection of the Grass tribe.

Let us, however, be contented with examining one of our own species for a knowledge of the structure of this singular tribe; we shall find every peculiarity of structure that tropical species afford, and we can easily imagine all that difference of size is likely to produce.

One of the commonest of British Grasses is the *Soft Brome-grass* (Bromus mollis, Plate XXII. 1.); a plant which you will be almost certain to meet

with in the first piece of waste ground. It is an annual with an erect stem, about two or three feet high, and covered all over with soft hairs. The stem requires more than mere external examination. Strip it of its leaves, so as to lay bare all its surface; and you will find it hard and thickened at every joint where a leaf has been torn. Split it, and instead of the solid centre of other plants, you will see that it is hollow, and consists of nothing but a cylindrical shell (*fig.* 2.); at the joints, however, the sides of the cylinder meet, and form a firm partition which completely separates one part of the stem from the other. It is this structure that renders the Bamboo so useful for forming cases to hold rolls of paper: in India they cut a truncheon of a stout Bamboo, and scrape away all the partitions except one; it then becomes a cylinder open at one end, where the partition is destroyed, and closed at the other end. A short piece of a Bamboo of the same diameter, having a complete partition at one end, is then formed into a lid by scraping away its inside, and a capital case is produced without farther trouble. We sometimes see such cases, as much as two feet in circumference.

The leaves of Brome-grass are hairy, narrow and sharp pointed at their lower end, which, notwithstanding its breadth, is considered to be their stalk; it rolls round the stem, forming a kind of sheath, which sometimes is not very easily unrolled. At the upper end of the sheath you may remark a thin white membrane, such as you have nowhere met with before; Botanists call such a membrane a LIGULA.

Thus far then we have two peculiarities in Grasses; their *hollow round stems, with partitions* at the joints, and the *ligulate leaves.*

The flowers are still more unlike what you have before seen. At the top of the stem of the Brome-grass, a number of slender branches appear, turned chiefly towards one side, and by their weight giving a somewhat nodding appearance to the parts they bear (*fig.* 1.); those parts (*a. a. a.*) are oblong green bodies, apparently composed of scales after the manner of a leaf bud; in reality they are little collections of flowers, whence they are named *spikelets* (or spiculæ or locustæ, as they say in Botanical Latin).

Each spikelet is constructed as follows. Firstly, at its base (*fig.* 3. *a. a.*) are two green scales, each of which has about five ribs; these are the GLUMES strictly speaking; there is no trace of either pistils or stamens in their bosom, on the contrary they are always found to be perfectly empty. When the glumes are removed you come to some other parts, which at first sight look like glumes; but on a more careful inspection you will remark that they are composed of more scales than one, have a stiff bristle at their back, and contain some stamens, &c. in their bosom. These are called FLORETS; in the Brome-grass there is about ten of them placed one above the other in two opposite rows (*fig.* 3. *b.*).

Each floret consists of two scales called PALEÆ (*fig.* 4. *a.* & *b.*); of which the more external (*a.*) is the larger, is covered all over the outside with soft hairs, and bears at its back a little below the end (*c.*) a stiff

bristle, called the BEARD, or AWN (arista); the beard is in reality the midrib of the palea, partially separated and lengthened out. The inner palea (*b.*) originates from above and within the base of the outer, is much smaller and more membranous, has its edges abruptly doubled inwards, and bears a row of stiff bristles on the angles (*d.*) formed by the doubling. These two are the lower or outer, and upper or inner paleæ.

Next the paleæ come, on the side of the outer palea, two exceedingly small scales (*fig.* 5. *a. a.*), which are much shorter than the ovary; they are called HYPOGYNOUS SCALES, and are supposed to be the rudiments of a calyx or corolla.

From the base of the ovary arise three stamens (*fig.* 4.), whose filaments are white, and so weak and slender, that the long narrow anthers hang in a state of oscillation, in consequence of the inability of the filaments to support them.

The ovary is a wedge-shaped body, apparently consisting of nothing but pulp, and crowned by a tuft of long hairs (*fig.* 5.); two styles, bearing singular brush-like stigmas, spring from its summit.

In this instance you have all the parts that are usually present in Grasses; and you cannot avoid remarking how widely different the whole organization is from any thing you have witnessed in other plants. The structure of the fruit is not less peculiar.

I have said that the ovary seems as if it were composed of nothing but pulp; it does, however, consist

of an ovule, and of a shell that includes it, but both are so soft that they grow together, and cannot be distinguished. Immediately after the styles wither, the ovary swells, gradually loses its softness, and at last when ripe is nearly bald, having gained a sallow appearance, and become longer and thinner. At the period of maturity (*fig.* 6.) there is still no means of separating the shell of the fruit from the skin of the seed, so completely are they grown together; the fruit looks therefore so like a seed, that it is no wonder it should popularly be called so; it is better, however, to designate it a GRAIN. If you crush the ripe grain you will find its contents of a hardish horny consistence, but easily reduced into the state of flour: from what you have seen in other instances you will easily recognize this for albumen. It is possible, that you may search in vain for an embryo, amidst all this flour; and I dare say, if I do not tell you how to look for it, you will waste a great deal of time in finding it, even if you should recognize it when found. Follow me attentively, and I shall easily relieve you of this difficulty. The ripe grain is much narrower at one end than the other, and more convex on one side than the other; turn the grain on its flat side, so that the convexity is uppermost, and then carry your eye to the narrowest end; there you will espy a minute oval depression (*fig.* 6. *a.*); if you carefully lift up the skin at this part, you will detect the embryo lying snugly half buried in albumen. It will appear like a greenish-yellow plano-convex oval body, in which you can discern no marks

of organization. But if you will divide it perpendicularly with a sharp knife, you will then be able to see that it has a most complete and highly developed structure. You will find (*fig.* 7.) that it consists of a thickish scale (*c.*) upon which lies a little conical body (*a.*), composed of several minute sheaths fitted one over the other; the scale is the cotyledon, and the conical body the plumule or young stem. At the lower end of the embryo may also be made out a sort of sheath lying within its extreme point (*b.*); it is the rudiment of the root.

When the embryo first begins to grow, the cotyledon (*c.*) swells a little and attaches itself firmly to the albumen by the whole of its highly absorbent surface: the albumen at the same time softening and becoming partially dissolved by the moisture it has taken up from the soil; by this means the nutritive matter of the albumen is conveyed into the cotyledon as quickly as it is formed. The food thus poured into the cotyledon by thousands of invisible mouths, causes it to swell and all its parts to lengthen. The radicle (*b.*) is pushed downwards into the soil on one hand, and on the other the plumule rises upwards into the air; both these parts are abundantly supplied with the materials of growth by the cotyledon, until the roots have established themselves in the soil, and are able to pump up food for themselves, and for the nascent stem. By the time this happens the cotyledon has shrivelled up, the albumen is exhausted of its nutriment, aud all these temporary parts cease to exist.

Such is the provision that nature has contrived to ensure the perpetuation of Grasses; for there is but little variation from this arrangement throughout the species of the tribe.

Here let us pause for an instant to admire the beautiful adaptation of all the parts to the functions they have to perform. Grasses spring up with rapidity as soon as the earliest rains have fallen upon the dry ground where their grains have been deposited; it is necessary that they should do so in order that, however imperfect the supply of rain may be, the earth may at all times be clothed with verdure. To ensure this, Providence has given them a young stem which is almost formed in the very seed, and which is ready upon the slightest stimulus to spring forth into life; but if the young stem were to sprout with such rapidity, the roots would be unable to supply it fast enough with food, and it would presently wither and die, unless some special means were provided of meeting this difficulty; accordingly, a great abundance of albumen is stored up, as a certain supply of food till the roots can themselves obtain it from the earth. The supply of the albumen would, however, be useless unless some means existed of conveying it with rapidity to the plumule, and accordingly we find the broad thin cotyledon, a highly absorbent body, placed with its whole surface applied to the albumen, and ready to transfer the nutritive fluid to the plumule as quickly as the former can be formed.

Grasses are so numerous and so very simple in

their structure that you may well believe there is some little difficulty in distinguishing them into genera; especially as their parts are so small. Although it is no part of my plan to teach you much of the distinctions of genera, that being left you to acquire from systematic works, when the difficulties of this introduction are mastered; yet I may as well explain how a few of the very commonest genera are known from each other.

What has already been said of the Brome-grass explains its characters. Very nearly related to it are *Fescues* (Festuca), the species of which, whether highlanders or lowlanders, are so much and advantageously employed as pasture Grasses; they differ from the Brome-grasses only in having their beard proceeding from the very point of the palea, instead of from below its point. Like both these are the *Meadow-grasses* (Poa); but they have no beards at all, and are usually much smaller: the little annual Grass which grows every where, and flowers at all seasons of the year, lying almost prostrate upon the ground, is a kind of Poa (P. annua). *Quaking-grasses* (Briza) are Poas with their paleæ inflated. All the above have a loose inflorescence, and several florets in each spikelet.

Others, having also a branched inflorescence, are known by each spikelet containing but one floret; such as *Bent-grasses* (Agrostis), with thin delicate silken panicles and wiry stems; they have often only one paleæ instead of two, or if they have two, the upper one is very minute. To Grasses with a similar structure also belong the *Feather-grass* (Stipa), with

its long and plumed beards, and *Catstail-grasses* (Phleum), with two equal sharp-pointed glumes; *Canary-grass* (Phalaris), too, with whose grains your Canary birds are fed, and whose glumes have each a flat keel like a little boat, and *Foxtail-grasses* (Alopecurus), which differ from the *Catstails* in having a beard to their single palea. In the *Catstails*, *Canary-grasses*, and *Foxtails* you will not recognize at first a branched inflorescence, for two of them derive their names from the compact appearance their flowers present. But if you separate the flowers gently, you will find that they are in reality seated upon little branches, which are pressed so closely together that you do not see them.

Another group of Grasses has the spikelets really seated close to the stem; as for instance *Wheat*, *Barley*, and *Rye*; while a fourth kind has the stamens in one kind of flower and the pistils in another: of this kind is Maize, or Indian Corn. In that plant the barren flowers are loose yellow branches, growing at the top of the stem, and covered with anthers, while the fertile flowers are hidden among the lower leaves, and are only discovered by their long shining styles, which hang down in tufts like silken tassels.

The other natural order of Glumaceous Monocotyledons, which I propose to mention to you is that which comprehends *Sedges*, after which it is named. In its general appearance it resembles Grasses; but it is known by its stems being solid, not hollow (Plate XXII. 2. *fig.* 2.), and by its leaf-stalks, when they roll round the stem, growing together by their edges

into a perfect sheath. These distinctions are the more important, from being accompanied by others in the parts of fructification, and also by an absence of all those useful properties for which Grasses are remarkable. The most common genus of the whole order is the *Sedge* (Carex); a species frequent on wet commons, called "the hairy" (C. hirta), will supply us with an illustration. Its solid triangular stem (*fig.* 2.), and its hairy leaves agree with what has just been mentioned. Its flowers are arranged in heads, and are of two kinds; one sort occupying the upper end of the stem (*fig.* 1. *a. a.*) consists of barren flowers only; each flower (*fig.* 2.) has an oval brownish membranous scale and three stamens, and the heads are composed of nothing but such flowers. The other kind of head (*fig.* 1. *b.*) appears a little below the others, is green, and consists of fertile flowers only. Like the barren heads this is chiefly composed of imbricated scales, but in place of the stamens you find (*fig.* 4.) a hairy bottle-shaped body, split at the end into two lobes, from between which three stigmas project. Open the bottle and you will discover that the stigmas are connected with a single style, springing from the top of a three-cornered ovary. This is all that the fertile flowers consist of; the bottle is formed by two scales which are placed opposite each other, and grow together at their edges, and is a mark of the genus Carex; most others of the Sedge tribe are without it, and contain nothing but a naked pistil. When the fruit (*fig.* 6.) of the Carex is ripe, it is still enclosed in the

bottle (*fig.* 5.), but it has become a hard 3-cornered brown nut, with a thickish shell, and one seed standing erect in its cavity (*fig.* 7. *a.*). As for its embryo it is totally different from that of Grasses, it neither lies on the outside of the albumen, nor is it shaped at all like it; it is a minute roundish undivided body (*fig.* 8.), which is buried in the lower end of the albumen. It really would seem as if the small comparative utility of these plants was indicated by the little care that nature has taken to ensure the growth of their seeds by extraordinary precautions.

' It is to the Sedge tribe that most of those plants belong, which are popularly considered Rushes, and which afford the materials of the manufacture of candles, mats, and chairs; the *Club-rush* in particular (Scirpus lacustris), which sometimes grows as much as nine feet high, is the species that is collected for such purposes. They are chiefly found on wet commons, or in marshy, or swampy places. The most remarkable of the wild kinds is the *Cotton-grass* (Eriophorum), the long silky white hairs of whose fruit look exactly like tufts of cotton blowing about in the wind.

Here ends my explanation of the organization of those plants which, because they are increased by the action of an apparatus consisting of calyx, corolla, stamens, and pistil, and forming what we call a flower, are called FLOWERING.

The remainder of the Vegetable Kingdom consists of species wholly destitute of flowers, and increased by organs totally different in their nature from fruit and

seeds. For an explanation of the characters of these, I must refer you to the succeeding letter.

EXPLANATION OF PLATE XXII.

I. The Grass Tribe.—1. A piece of the inflorescence of *Soft Brome-grass* (Bromus mollis); *a a* spikelets.—2. A perpendicular section of a portion of the stem, shewing the partition at *a*.—3. A spikelet; *a a* glumes; *b b b* florets.—4. A floret half open; *a* the lower palea; *b* the upper palea; *c* the beard; *d* the angles of the upper palea covered with stiff hairs.—5. A pistil; *a a* hypogynous scales; *b* stigmas.—6. A ripe grain; *a* the place where the embryo lies; *b* the piece which is cut out, and seen magnified at 7, where *a* is the plumule; *b* the radicle; *c* the cotyledon, and *d* the albumen.

II. The Sedge Tribe.—1. A portion of the upper end of the *Hairy Sedge* (Carex hirta); *a a* barren flower heads; *b* fertile flower head.—2. A portion of the solid stem.—3. A barren floret seen from the inside, with its three stamens.—4. A fertile floret.—5. A ripe fruit, as seen when enclosed in the bottle.—6. The true fruit taken out of the bottle.—7. A perpendicular section of the same, shewing its erect seed *a*.—8. An embryo.

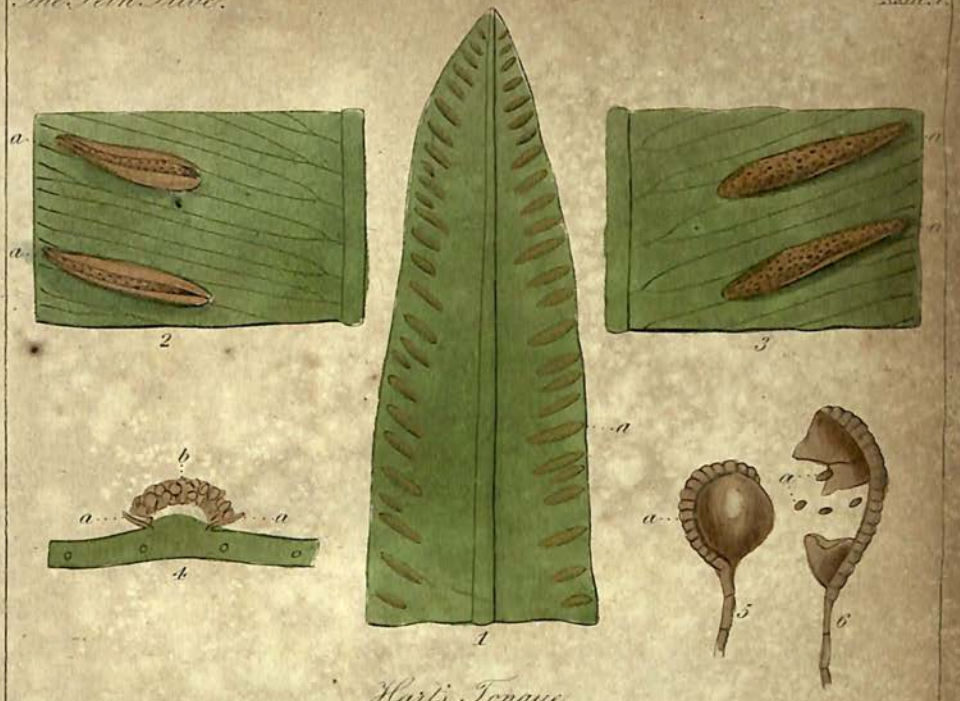
LETTER XXIII.

CELLULAR, FLOWERLESS, OR CRYPTOGAMIC PLANTS—THE FERN TRIBE—THE CLUB-MOSS TRIBE.

Plate XXIII.

We have now arrived at the frontiers of the third great province into which the Vegetable Kingdom is divided; we are about to visit races far less perfectly organized than those of the two other provinces; and we shall no longer be delighted by beautiful form, or astonished at stupendous size, or interested by the many useful purposes to which the species are applied. We here lose sight of all traces of flowers, and of the singular parts that belong to them; in their room we find a different mode of propagation, and along with it, a plan of organization which is always far more simple than in flowering plants, and which gradually diminishes in complexity, till at last the component parts of the vegetable texture are separated, and nothing remains but little bladders, which are hardly to be distinguished from the simplest forms of animals.

Plants of this sort are called FLOWERLESS; they are also named *Cryptogamic*, because the parts by which they are by some thought to be increased are hidden from view; and they have, in addition,



Hart's Tongue.

Common Club-moss.

the designation of CELLULAR plants, because their stems rarely contain vessels, but usually consist of cellular substance only. You, perhaps, do not know that, in nearly all plants which bear flowers, there are present those curious air-pipes, called spiral vessels, of which I long ago gave you an explanation (p. 38.); such, however, is the fact. On the other hand, in these flowerless plants, spiral vessels are universally absent; some of the most highly organized tribes, such as those which form the subject of the present letter, have a particular kind of vessel in lieu of the spiral; but all the other tribes are destitute of vessels of any kind.

Ferns, which are the most completely organised of Flowerless plants, and which approach nearer than any others to the Flowering tribes, are those to which I would first call your attention. In the northern parts of the world, they are green leafy productions, which die down to the ground every year; and they are seldom more than two or three feet high; one of the larger kinds is the *Brake* (Pteris), which is so much esteemed as covert for game. But, in tropical countries, many of them far surpass these pigmy dimensions; they acquire real trunks, resembling those of Palms, and often rise to as high as forty or fifty feet without a leaf; even a more considerable stature is spoken of by travellers. At all times they are graceful objects, from the slender wiry stems on which they bear their leaves, which wave in the breeze like plumes of feathers, and from the multitude of leaflets into which they are cut with

the most exquisite regularity. But the Tree Ferns of the Tropics are said to be most superb objects, combining the grace and agreeable colour of their European kindred with the majestic aspect of the Palms.

It is usual to call the leaves of Ferns by the name of FROND, as if their leaves were not analogous to those of other plants. But I see no use in continuing this old fashioned word, which was coined at a time when the leaf of a Fern was thought to be a sort of compound between a branch and a leaf. It is much better, on every account, to call it by the name that the same part bears in other plants.

For the purpose of studying the organization of Ferns, I recommend you to take a leaf of *Hart's-tongue* (Scolopendrium officinarum, Plate XXIII. 1.), a plant which is common on most damp and shaded banks, and within old open wells, the mouths of which are almost choaked up by it. All that you will find of the plant, is a brown scaly rootstock, from which grow a number of handsome lance-shaped leaves, of a deep green colour, placed upon a shining ebony-black stalk. If the leaves are newly formed, you will, by holding them up against the light, readily see their veins, which are dissimilar to those of all other plants. They neither resemble Monocotyledons, nor Dicotyledons; are neither netted nor parallel; but have a simply forked structure. You will remark, that, although now and then, one vein may be found running straight from the midrib nearly up to the margin, without dividing, yet, that the principal part fork very soon after the vein has left the

midrib, and that, sometimes, one of the branches forks again. This kind of vein is peculiar to Ferns, and will enable you, at all times, to recognise them whether their reproductive parts are present or not.

After the leaf has been growing some little time, you may remark a number of narrow pale bands appearing at pretty equal intervals upon some of the veins, and following their direction (*fig.* 1. *a.*). Presently afterwards the whole of the skin of the leaf, where these bands are, separates from the green part below it: in course of time, something swells and raises up the skin, till at last it bursts through it, separating the skin into two equal parts, one edge of which remains adhering to the leaf (*fig.* 2. *a. a.*). At this period this cause of the swelling is discovered; it consists in a multitude of brown seed-like grains that are crowded together very closely, and form a brown ridge (*fig.* 3. *a. a.*). Botanists call the skin which separates from the leaf the INDUSIUM, the ridge SORUS, and the seed-like grains THECÆ. In order to gain a distinct view of all these parts, you should cut through the leaf across the sorus, just after the indusium has burst; and then the edges of the indusium will be distinctly visible (*fig.* 4. *a. a.*), with the ridge-like receptacle of the thecæ rising up between them (*fig.* 4. *b.*).

The only means of propagating itself, which the Hart's-tongue possesses, resides in the thecæ. It has no calyx, corolla, stamens, or pistillum, and consequently neither fruit nor seed; nevertheless it can perpetuate its kind with the same certainty as the most perfect plant. The theca (*fig.* 5.) is not a seed,

nor is it a body whose functions are of a nature similar to those of the seed; you require a pretty good microscope to examine it correctly, but with such an instrument you will make it out to be a roundish compressed body, seated on a jointed stalk, which runs up one side of the theca (*fig.* 5. *a.*). Upon examining a good many of the thecæ, you will no doubt remark some of them burst open (*fig.* 6.); and then you will find that they are hollow bodies, containing a quantity of extremely minute oval grains (*fig.* 6. *a.*), called SPORES, by Botanists. It is in the spores that the power of increase resides; every one of them will form a new plant, and consequently they are analogous to seeds; but, as they do not result from the action of pollen upon a stigma, they are not real seeds, but only the representatives of those organs amongst Flowerless plants.

How simple is all this; how different from every thing we have seen in other plants! and yet no doubt as perfectly adapted to the multiplication of Ferns as any more complete contrivance. How prodigious too is the power that these plants possess of disseminating themselves! Hart's-tongue, owing to its small size, is one of those in which the power resides only in a small degree; and yet a little computation will shew even its means to be prodigious. Each of its sori consists of from 3000 to 6000 thecæ; let us take 4500 as the average number. Then each leaf bears about 80 sori; which makes 360,000 thecæ per leaf; the thecæ themselves contain about 50 spores; so that a single leaf of Hart's-tongue may

give birth to no fewer than eighteen millions of young plants.

The form and situation of the sori is not, in other genera, the same as in the Hart's-tongue; on the contrary, it is upon differences in those respects that the genera have been established. For example in *Shield-ferns* (Aspidium) the sori are round and covered with a kidney-shaped indusium; in *Polypody* (Polypodium) they are round and have no indusium; and in the graceful *Maiden-hair-ferns* (Adiantum) they are oblong bodies arising from the edges of the leaf. The most curious arrangement of their parts is in the *Brake* itself (Pteris); no matter at what time of the year you examine the leaves of that plant you will probably discover no trace of sori, and yet it would be difficult to find a Brake-leaf in the autumn, which does not abound with them. The truth is that in this plant they occupy so singular a position, that one could almost be tempted to believe that they were designedly hidden where none but the curious Botanist should find them. Look attentively at the under side of the leaves: you will remark the margin to be turned in and thickened, like the hem of a lady's gown in which a cord in run; there lurk the thecæ you are in search of. With the point of a knife lift up gently the edge of the leaf, and you will at once discover a ridge of thecæ running all round it; in this instance the margin of the leaf acts the part of indusium.

Another singular form of Ferns is that in which the whole of the segments of a leaf are contracted and

curled up round the thecæ, so as to lose entirely the natural appearance, and to resemble a sort of inflorescence. A striking instance of this is not uncommon in bogs, in the form of a plant called the *Osmund-royal*, or *Flowering Fern* (Osmunda regalis); a minute species found in woods, and called *Adder's Tongue* (Ophioglossum), because of its narrow inflorescence, is another British example.

Such is the first and highest degree in the scale of organization among Flowerless plants. Possessing a system of vessels, frequently attaining a considerable size, having leaves intersected by veins, and having their surface provided with breathing pores. Ferns may be considered to differ from Flowering plants in little except in the manner in which they are propagated, and in the organs assigned them by nature for that purpose. Next to them is arranged a small tribe also possessing a system of vessels in the stem, and breathing pores on the surface, but destitute of veins, and having a remarkably different mode of reproduction; you will find, indeed, that there is this great peculiarity in Flowerless plants, independently of all others, that no two tribes agree exactly in the nature of their organs of propagation. While in Flowering plants one tribe is distinguished from another by slight variations in the form, or number, or proportions of a few organs that they all possess in common, you will find among Flowerless plants, on the contrary, that every tribe has an independent and peculiar provision of its own for the perpetuation of the species.

This is the case in the *Club-moss tribe* (Lycopodiaceæ, Plate XXIII. 2.), to which I have alluded. *Club-mosses*, in some parts of England called also *Snake-mosses*, are humble plants which grow on moors or heaths, or half-drained bogs, over which their scaly stems creep and interweave. There are no veins in their leaves, which are for the most part narrow, and taper-pointed. When about to reproduce themselves, they emit from the ends of their branches, which are usually forked like the veins in a Fern-leaf, a slender shoot of a paler colour than the remainder, and terminated by a yellowish thickened oblong, or club-shaped head. Among the hair-pointed leaves of the head lie, one in the bosom of every leaf, pale yellow cases, opening by two or three valves (*fig.* 1.), and containing either a fine powdery substance, or a few large grains or spores. These are all the means such plants have of propagating themselves; and it is uncertain what the exact difference is in the purposes to which the powder and the spores are severally destined. The latter, no doubt, grow like seeds, but it is not quite certain that the powder grows also; there are those who say they have seen the powder grow, but their observations require to be repeated.

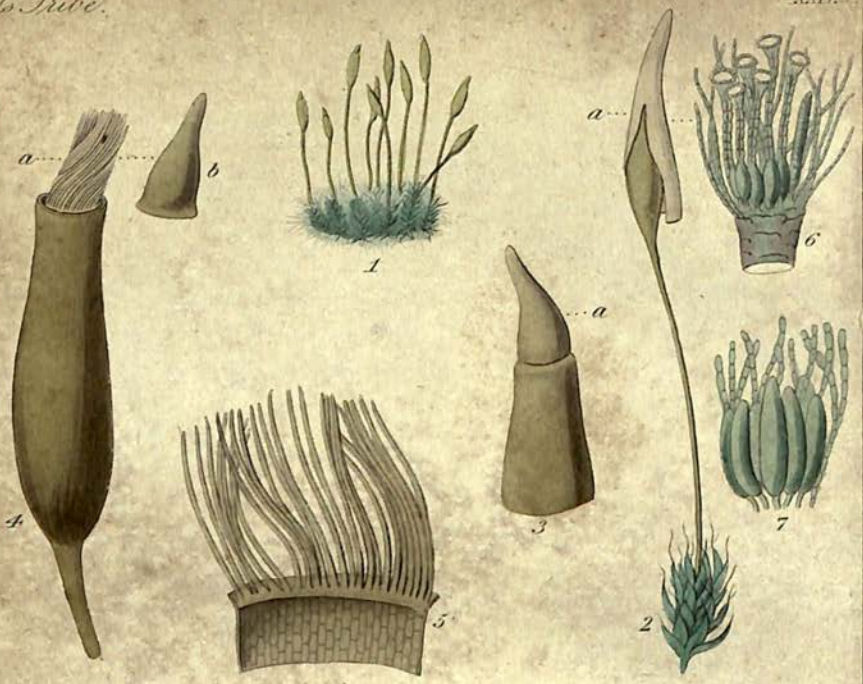
Such plants seem to occupy an intermediate place between Ferns and Mosses, to the latter of which my next letter will refer. I will not detain you about them further than by remarking, that although they are now seldom more than three or four feet long, and are generally much smaller, it is probable that either similar

plants, or races very closely allied to them, grew in ancient days, long before the creation of man, to a size far beyond anything that the present order of things comprehends; this is, however, a geological matter, with which we had better not interfere.

EXPLANATION OF PLATE XXIII.

I. THE FERN TRIBE.—1. The upper end of a leaf of *Hart's-Tongue* (Scolopendrium officinarum), seen from the under side; *a* sori.—2. A portion of a leaf magnified, to show the veins and the structure of the sori, *a a*, more distinctly.—3. A similar portion, further advanced; *a a* sori.—4. A section of a portion of a leaf across the sorus; *a a* the two valves of the indusium; *b* the sorus itself, covered with thecæ.—5. A theca; *a* its elastic back.—6. Another theca burst, and scattering its sporules, *a*.

II. THE CLUB-MOSS TRIBE.—A plant of *common Club-moss* (Lycopodium clavatum).—1. A theca, with its two valves open, and the leaf out of whose bosom it grows.—2. The same leaf seen from behind.—3. A theca, as seen when closed.



Wall Tortula.

Grove Jungermannia.

LETTER XXIV.

THE MOSS TRIBE—THE JUNGERMANNIA TRIBE.

Plate XXIV.

STILL lower in the scale of creation, than Ferns and Club-mosses are the true *Mosses;* plants destitute of all traces of vessels and of breathing pores; with no true veins in their leaves, and so pigmy in growth, that the most gigantic of them hardly equal the smallest of the Club-mosses.

Up to the present moment, a microscope has rarely been necessary in our studies; whenever I have recommended you to employ it, the subject would usually have admitted of your dispensing with its aid, if you had pleased. But from this time forward it must be constantly in your hand, and every observation must be made with it. You will, however, find abundance of most curious and interesting results, to idemnify you for the trouble it will give you.

Mosses are among the smallest of plants with true leaves; they are often so minute that the whole specimen, leaves, stem, fruit, and all, would escape the eye, if they did not grow in patches; and they never, in the largest kinds, exceed the height of a few inches. Nevertheless, they are organized in a man-

ner far more complete than Ferns, or Club-mosses, although they are destitute of air vessels and breathing pores. Mosses are usually the first plants that shew themselves on rocks, or walls, or barren places, where no other vegetation can establish itself; provided the air is damp they will flourish there, and in time, lay the foundation of a bed of vegetable mould, in which the roots of grasses, and other stronger plants may find support, till they, in their turn, have decayed and prepared the way for shrubs and trees. This is the usual order observed by nature in converting the face of rocks into vegetable mould, and thus you see Mosses have to perform the office of pioneers to larger plants, an office for which one would have thought their Lilliputian size would hardly have qualified them.

Mosses are formed upon precisely the same plan as flowering plants, as far as the arrangement of their organs of vegetation. They have, in all cases, a stem, or axis, however minute, round which the leaves are disposed with the greatest symmetry—(Plate XXIV. 1. *fig.* 2.); they have the parts that answer to seeds, enclosed in a case, and this case is elevated on a stalk, which arises from among the leaves. But, beyond this, analogy ceases; in all other points of structure, the Moss tribe is of a most singular nature.

Mosses are said to be in fruit when the stems are furnished with brown hollow cases, seated on a long stalk (*fig.* 1. 2.). It is chiefly of this fruit, or theca, or sporangium, and its modifications, that we make use

in distinguishing the genera. Let it, therefore, engage our attention the first. No species can be more common than *Wall Tortula* (Tortula muralis), dark tufts of which are found every where upon the north side of walls, growing out of the mortar. The theca of this plant wears a little cap, not very unlike that of the Norman peasant women (*fig.* 2. *a.*), with its high peak and long lappets; this part is called a CALYPTRA; when young it was rolled round the theca, so as completely to cover it over like an extinguisher, but when the stalk of the theca lengthened, the calyptra was torn away from its support, and carried up upon the tip. After a certain time, the calyptra drops off; and, at that time, the theca is in the best state for examination. You will find it terminated by a conical lid (*fig.* 3. *a.*), or OPERCULUM, which is thrown off when the spores, or reproductive parts, are fit to be dispersed (*fig.* 4. *b.*). When the lid has been thus spontaneously thrown off, a new and peculiar set of parts come in view; you will find that the lid covered a kind of tuft of twisted hairs, which at first look as if they stopped up the mouth of the theca. But, if you cut a theca perpendicularly from the bottom to the top, you will learn from the sectional view that you will then obtain of the parts, that, in reality, the hairs arise from within the rim of the theca, in a single row (*fig.* 5.). These hairs are named in Botany, the TEETH of the fringe, or PERISTOME; the latter term designating the ring of hairs. The nature of the fringe varies in different genera; sometimes it consists of two rows of teeth, differing from each

other in size or number, or arrangement; some have only 4 teeth, others 8, or 16, or 32, or 64; in all cases, their number is some multiple of four; a curious circumstance which shews the great simplicity of design that is observed in the construction of these minute objects. The fringe is not, however, always present; there is a small section of the Moss tribe, all the genera of which are destitute of that singular organ. What office it may have to perform, we can only guess; it seems to be connected with the dispersion of the spores, and often acts in the most beautiful hygrometrical manner. If you take the theca of this Tortula, for example, when dry, and put it in a damp place, or in water, its teeth will uncoil, and disentangle themselves with a graceful and steady motion, which is beautiful to look upon.

It is in the inside of the theca that the spores are confined. They lie there in a thin bag, which is open at the upper end, and which surrounds a central column, called the COLUMELLA. They are exceedingly minute, and not unlike the spores of Ferns.

A superficial observer would remark no further organization than this; but the accurate investigations of Botanists, have led to the discovery, that there is a more minute and concealed system of organs, which, in many cases, precedes the appearance of the theca. It has been thought that these organs represent pistils and anthers of an imperfect kind; but you will see that, if they are to be so understood, they are so much more imperfect and so differently constructed from the parts that bear those names in

flowering plants, as to render it extremely doubtful whether they can really be considered of the same nature.

At the end of the shoots of some Mosses such as *Hairmoss* (Polytrichum), the leaves spread into a starry form, and become coloured with brown. Among them lie a number of cylindrical whitish-green bodies (*fig.* 7.) which are transparent at the point, and filled with a cloudy granular matter, which it is said that they discharge with some degree of violence. These are considered to be anthers. But they appear to exist in some Mosses only, and not to be universally present, as they would be if they were really necessary to produce fertilization.

The second kind of apparatus is universally provided, and is in reality the forerunner of the theca. In the bosom of other leaves you may find, a short time after Mosses have begun to grow, a cluster of little greenish bodies (*fig.* 6.), which are thickest at their lower end, then taper upwards into a slender pipe, and at last expand into a sort of shallow cup. After a certain time the pipe and the cup, which, by some, are considered style and stigma, shrivel up, and the lower part, or ovary, swells, acquires a stalk, and finally changes into a theca.

The study of the distinctions of Mosses requires great care and attention, and much skill in the use of the microscope. It has sometimes occupied the undivided attention of Botanists, and cannot be attended to without much leisure and patience. The best work we have upon the subject is the Muscologia

Britannica of Drs. Hooker and Taylor, a valuable book, in which are accurate figures of nearly all the species found in this country. To it I refer you, if you wish to prosecute this branch of Botany.

Of about the same rank in the scale of organization are the plants called *Jungermannias*, which look very much like Mosses (Plate XXIV. 2. *fig.* 1.), and which like them have little roundish bodies called anthers (*fig.* 4. & 5.) and a theca (*fig.* 2. *c.*) elevated on a stalk. They are distinguishable; firstly, by their theca bursting into valves, and secondly, by their spores being mixed with tubes, formed of curiously twisted threads (*fig.* 9.), and called ELATERS. They grow in tufts and patches, in damp and shady places all over Great Britain, occupying the bark of trees, and the surface of rocks and stones, or creeping among the herbage on the banks of rivers, on heaths, marshes, and in shady woods, and even inhabiting gloomy caverns where scarcely any other vegetable can exist. A noble illustration of these tiny plants was published some years ago by Professor Hooker; it forms the most complete local monograph of any genus ever published, and is indispensable to all those who would occupy themselves with an inquiry into the habits and differences of the tribe.

EXPLANATION OF PLATE XXIV.

I. The Moss Tribe.—1. A patch of *Wall Tortula* (Tortula muralis) of the natural size.—2. A single plant magnified; *a* calyptra.—3. A part of a theca with the lid *a*.—4. A theca from which the lid *b* has been removed; *a* the twisted fringe.—5. A portion of the theca viewed from within; shewing the teeth of the fringe.—6. A cluster of the young thecæ of Encalypta vulgaris, intermixed with succulent fibres.—7. A cluster of the bodies supposed by some to be anthers, in the same plant.—The two last figures are after Hedwig.

II. The Jungermannia Tribe.—1. A plant of the *Grove Jungermanniá* (J. nemorosa), natural size.—2. A portion of the same magnified; *a* leaves; *b* the sheath of the theca, sometimes called the calyx; *c* the theca emitting its spores.—3. A leaf, bearing little warts, *a a*, which break up into reproductive particles *b;* and are called *gemmæ*.—4, 5, 6.—One of the bodies supposed to be anthers, in different states, with the succulent filaments that are intermixed with them.—7. The calyptra of the theca, a little broken at its side.—8. Imperfect young theca.—9. Two of the elastic elaters, with the spores that are mixed among them.—These figures are copied from Hooker's British Jungermanniæ, Tab. 21.

LETTER XXV.

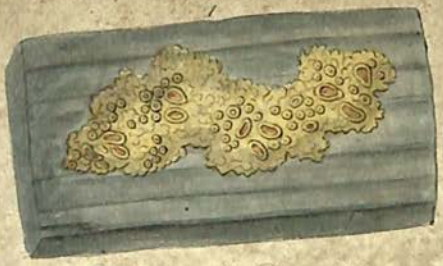
THE LICHEN TRIBE—THE MUSHROOM TRIBE—THE SEAWEED TRIBE.

Plate XXV.

At last we have nearly reached the limits of the vegetable world, and find ourselves upon the confines of that mysterious region where animal and vegetable natures become so blended, that the philosopher is obliged to admit the weakness of his systematical distinctions, and to abandon the attempt at drawing a line between vitality and volition. In explaining to you the structure of the three lowest tribes in the vegetable kingdom, I do not propose to fatigue your attention by the minute, and specific details in which they so peculiarly abound; but I shall content myself with sketching out the great features by which they are usually distinguished.

When we quit Mosses and Jungermannias, with the other plants of a similar nature, we find ourselves among beings in which all traces of stems and leaves have disappeared, and which consist of nothing but thin horizontal expansions of vegetable matter in which a few harder, and differently formed kernels or shields are imbedded. In some of these the colour

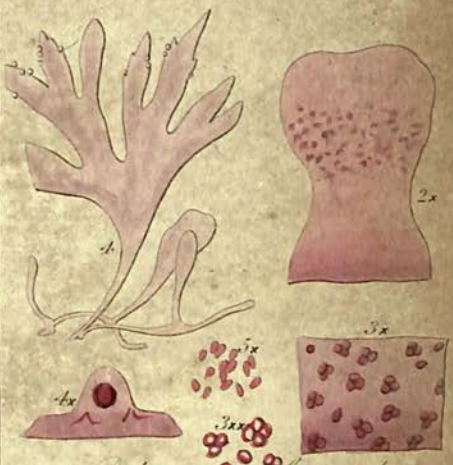
The Lichen Tribe. XVI. 1.



Yellow wall Parmelia.

The Seaweed Tribe. XVI. 2.

Capillary Conferva.



Palmetta Sea weed.

The Mushroom Tribe. XVII. 1.

Veiled Agaric &c.

is yellow, brown or green, the texture of the expansion leafy, and the margin cut up into many lobes; these are the most nearly related to leafy and more perfect plants (Plate XXV. 1. *fig.* 1. & 2.); in others the expansion is merely a thin crust, which readily crumbles in pieces, the species having scarcely vital energy enough to keep the cells of which they are composed in a state of cohesion. Such plants as these are called *Lichens.* They are found chiefly in the temperate or colder regions of the earth. Some of them (Gyrophoras) crawl upon the surface of the earth, spreading their dingy, cold, and damp bodies over whole plains in the desolate regions of the north; others (Usneas, Ramalinas, &c.) spring up on the branches of trees, and hang down from them like grey and netted beards, giving the unfortunate plants of which they take possession, a hoary wintry aspect even in the summer; some (Parmelias, Lecideas, &c.) overrun old walls, stones, and rocks, to which they communicate those mild and agreeable tints, which render ancient ruins so peculiarly pleasing to the eye; and finally a fourth description of Lichens (Opegraphas) establish themselves upon the bark of living trees, occasionally burying themselves beneath the skin, through which their shields alone peep forth in the strange form of the letters of some eastern tongue.

Plants of this tribe have no parts in the smallest degree resembling flowers; they have no certain mode of multiplying themselves except by the dispersion of little spores, which are nothing but ex-

ceedingly minute cells that are lodged in the centre of the shields. These are very difficult to find; you may, however, make them out if you observe the following directions. Take the full grown shield of any Lichen; that of the *Yellow wall Parmelia* (P. parietina) is a good one for the purpose (Plate XXV. 1. *fig.* 2.); with a sharp razor divide it perpendicularly; then shave off the thinnest possible slice of one of the faces, and drop it into water; place it on the glass stage of a microscope, and illuminate it from below. You will then be able to perceive that the kernel consists of a crowd of minute compact fibres, planted perpendicularly upon a bed of cellular substance (*fig.* 3.); and that in the midst of the fibres there is a great number of little oblong bags (*fig.* 3. *a.*) filled full of transparent cells (*fig.* 4.); the bags are thecæ, the cells are spores; and it is to the latter that the Lichen has to trust for its perpetuation.

The study of Lichens is probably the most difficult of any part of Botany; the species are scarcely to be distinguished, the limits of the genera are uncertain, and the characters by which they are separated are obscure. If, however, you are curious to make yourself acquainted with these, the best book I know of to recommend to you, is the fifth volume of the English Flora, by Professor Hooker.

Notwithstanding their minuteness and uninviting appearance, several of them are of considerable importance to man and animals. The Arctic *Gyrophoras* called by the Canadians *Tripe de Roche*, were the only food that the daring travellers Franklin,

Richardson, and Back, were for a long time able to procure in the horrible countries they so fearlessly visited in the cause of science; *Reindeer Moss* (Cladonia rangiferina) is the winter food of the Reindeer of the Laplanders; *Iceland Moss* (Cetraria islandica) furnishes a nutritive food to the invalid; and finally the production of *Orchil*, by Roccella tinctoria is an indication of the value of some species to the manufacturer as dyes.

Very closely related to Lichens, and standing almost parallel with them in the scale of organization, are *Fungi*, or the *Mushroom tribe* (Plate XXV. 3.), plants with which we are best acquainted from our knowledge of the common eatable Mushroom, but which have almost an endless diversity of form and organization. In this, however, they are all agreed, that while the theeæ of Lichens are placed in shields or receptacles, which are exposed to the air, those of Fungi are in all cases concealed by a covering of some kind. To give you any thing like an accurate notion of the many different appearances of Fungi, would be wholly impracticable in a work of this kind; Dr. Greville's Scottish Cryptogamic Flora should be your guide, if you would dip deeply into the mysteries of their organization. They vary from simple cells that hardly adhere, to chains of cells which resemble a necklace, thence to hollow balls, infinitely minute, that are generated in the living substance of leaves and stems, which they afflict under the names of mildew or blight, these again are developed in subterranean masses of cellular sub-

stance, such as the Truffle, and finally arrive at their most perfect state in the Agarics, or Mushrooms, that we eat, and in the Boleti, which grow like huge fleshy excrescences on the trunks of trees, or project from their trunks in long and ugly lobes, which have in one case been compared to the claws of some gigantic demon.

Instead of occupying you about the particulars of all these matters, I shall content myself with explaining to you the nature of the developement of one of the most completely formed fungi, *the veiled Agaric* (Agaricus volvaceus). In the beginning this plant is nothing but a thin layer of cobweb-like matter, spreading among old tan; by degrees, on the surface of the cobwebs appear little protuberances of a whitish colour (Plate XXV. 3. *fig.* 1.); they gradually lengthen, and acquire a sort of stalk, and up to a particular period consist of only a fleshy mass of fibres and minute cells; if they are cut through at that time in a perpendicular direction (*fig.* 2.), they present one uniform face. But in a short time a minute cavity is formed in the fungus at the thicker end (*fig.* 3.), within which a sort of cap is gradually elevated upon a stalk (*fig.* 4.); the cap and stalk keep progressively enlarging (*figs.* 5, 6, 7, 8.), and stretching the skin within which they are enclosed, till at last the skin cracks (*fig.* 10.); the cap and its stalk rapidly enlarge, and tear a way through the skin (*fig.* 11.) and at last burst forth into light, a perfect mushroom (*fig.* 12.), with numerous cinnamon brown *gills* or LAMELLÆ radiating from the

stalk underneath the cap, and concealing the spores within their folds. When the Mushroom has gained its full size, its stalk is surrounded at the base by a thick fleshy sheath, called the VOLVA, or *wrapper;* from what you have seen of its gradual progress, you will have observed that the wrapper is nothing but the remains of the skin within which the fungus was formed. I send you a copy of a beautiful illustration of these phenomena by Professor Th. Nees v. Esenbeck, of Bonn, by whom they were observed.

So simple is the growth of this and such plants, and so remarkable are the circumstances under which they are formed, as to have given rise to the belief that they are not propagated by the agency of spores, which are always sure to reproduce the plant from which they originate, but are dependent for their peculiar appearances upon the different circumstances under which they are developed. Professor Nees v. Esenbeck has proved that whatever error there may be in such opinions generally, they are at least well founded in the case of the Veiled Mushroom; for he ascertained, by careful observation, that the same cobwebby matter which gave birth in hothouses to the Mushroom, in long and bright days when there is plenty of light, produced nothing but a plant called Sclerotium Mycetospora, in the autumn, winter, and spring, when the hothouses abounded with heat and moisture, but when the days were short, the sky cloudy, and light deficient.

The last and lowest of all the tribes of plants are the *Sea-weeds* and their allies; these productions

which inhabit water exclusively, and appear at one end of the scale of their developement in the form of enormous Fuci, many fathoms in length, but at the other as merely simple bladders sticking together in rows, are those to which I referred at the beginning of this letter, as forming the link between the Animal and Vegetable worlds. Like Lichens and Fungi, they have reproductive organs of the most simple construction; in those species which have the most complex organization, the spores are stored up in peculiar receptacles, as in the larger and more perfect sea-weeds; but in others they are distributed vaguely through the whole substance of the plant, and start into life when liberated from their nests by the destruction of the individual that generated them. In the *Lavers*, whether of fresh or salt water, they lie clustered in threes or fours, in the substance of a green membrane; in the true Confervæ they are nothing but granular matter, locked up in little transparent tubes (Plate XXV. 2.). It is of a vegetation of this latter kind that consist the green slimy patches you see floating in water, or adhering to stones and rocks from which water has receded. In Dr. Greville's Algæ Britannicæ, and in the fifth volume of the English Flora, you will find a full account of the genera and species of these singular productions.

What is most remarkable in them is their approach to the nature of animals, an approach which is not only indicated by the apparently spontaneous motions of the kinds called Oscillatoria, but in a much more unequivocal manner by other kinds, if we can

believe the concurrent testimony of several French and German Botanists. No one has investigated the subject with more unwearied assiduity than Mons. Gaillon, from whose "Observations sur les limites qui séparent le regne Végétal du regne Animal," I shall translate some details that I think cannot fail to amuse and surprise you.

On the rocks that are found at low-water mark on the coasts of Normandy and Picardy, there grows a production called by Botanists *Conferva comoides;* it consists of fine brownish-yellow threads, collected in the form of a hair-pencil, half an inch or an inch in length, and at low water spreads over the surface of the little round calcareous stones, to which it gives something of the appearance of the head of a new-born child. These threads are loosely branched, and are finer than the most delicate hair; the plant owes its apparent solidity to the clustering and entanglement of many such threads. Viewed under a microscope that magnifies 300 diameters, the threads seem to be rounded, slightly compressed, and about as large as fine packthread. They are of a mucous nature, and contain immersed within their substance a number of small yellowish bodies, which look at first like dots, afterwards become oval, and end in acquiring something the shape of a radish, having the ends transparent, and the centre marked by a patch of yellowish matter. If they are at that time separated from the mucous matter in which they are pressed and packed like herrings in a barrel, you may see them moving, expanding, contracting, advancing

gravely and slowly, retreating in like manner, altering their direction, and finally possessing a spontaneous, incessant, measured, voluntary motion. These little creatures, which at most are not more than the 1000th of an inch long, and at the smallest hardly exceed the 5000th, when once they are separated from the thread that contains them, fall down in countless multitudes, in the form of a chocolate-brown deposit, on the neighbouring rocks. Once there, they distend, and emit a globule of coloured particles, which are evidently their fry. Each particle gains motion and volume, and the little globular mass, lengthening and branching, reproduces, by the developement of the germs that are collected together, the long green pencilled appearance, which has led Botanists to consider this being as a plant.

In another production, *green ditch-Laver* (Ulva bullata, or minima, or Tetraspora lubrica), still more astonishing circumstances have been observed by M. Gaillon and others. This plant appears, to the naked eye, a thin green membrane, within which the microscope reveals a number of green granules, arranged in fours. Let this membrane be kept in quiet water, and at a high atmospheric temperature, and the granules may be seen, under a powerful microscope, to present at their surface certain convexities and depressions, which are the effect of the repeated contraction and distension of these granules. If they are carefully watched for several days, the granules will be seen to be reciprocally displaced; after a certain time they separate from the membrane, and may

then be perceived to have a rapid and regular movement, as if in chase of each other; cool with a drop of water, that in which the granules are floating, and their motions will become slower, they will attach themselves by some part of their circumference, and will acquire a swinging motion from right to left and from left to right. In this sort of imperfect reeling and twirling, one sees the granules approach in pairs, just touch each other, retreat, approach again, and glide away to the right or left, staggering, as it were, and trying to preserve their balance; at last, instead of pairs, fours combine to execute the movements of the dance. Imagine the field of the microscope covered, shortly after, with a hundred of these animated globules, whose diameter is not, in reality, more than the 4000th of an inch, chasing each other, retreating, and intermingling, as if executing the mazes of a fantastic reel, and you have one of the most curious spectacles that the microscope can exhibit. When great numbers of the granules are collected, the motion ceases; they then collect in fours, and form a new membrane, and in this state they are considered by Botanists as a kind of vegetable.

Such are, in part, the wonders revealed by the microscope in these ambiguous productions; many others of equal interest might be named, but what has been said will suffice to shew you how marvellous a store of curious facts remains to be collected by those whose time and disposition are favourable to such inquiries. To these may be applied

the lines of the French poet Delile, even better than to the zoophytes to which allusion was more particularly made:—

Voyez vous se mouvoir ces vivans arbrisseaux
Dont l'étrange famille habite dans les eaux,
Et qui, de deux états nuance merveilleuse
Confondent du savoir l'ignorance orgueilleuse.
De l'humile séjour ces douteux habitans
A l'œil inattentif échappèrent long-temps;
Ils vivaient inconnus, et sujets de deux mondes,
En se multipliant voyageaient sur les ondes.

EXPLANATION OF PLATE XXV.

I. The Lichen Tribe.—1. A specimen of the *Yellow Wall Parmelia* (P. parietina), growing on a piece of pale.—2. A section of the same magnified.—3. A perpendicular section of a shield; *a a*, thecæ, with the spores in them.—4. The spores.

II. The Sea-weed Tribe.—1. A mass of *Capillary Conferva* (C. capillaris).—2. A thread highly magnified.—1*. *Palmetta Sea-weed* (Rhodomenia palmetta), natural size, with its masses of reproductive matter.—2*. A portion of the plant with reproductive particles collected in clusters of 3 or 4.—3*. A portion of the last highly magnified.—3**. Clusters separate.—4*. A bit of the plant with one of the masses of reproductive matter.—5*. Spores.—The latter after Greville.

III. The Mushroom Tribe.—1. A patch of tan, on which young plants of the *Veiled Agaric* (Agaricus volvaceus) are growing.—2—8. Progressive developement of a young plant.—9. A plant just ready to burst its wrapper.—10. The same bursting its wrapper.—11. A plant emerging from the wrapper, *a*.—12. A perfect plant; *a* the wrapper, or volva.—(After Th. Nees von Esenbeck.)

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